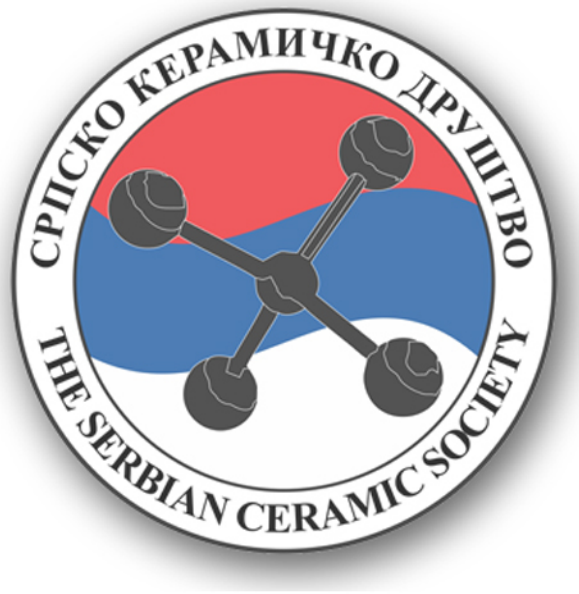

Serbian Ceramic Society Conference
ADVANCED CERAMICS AND APPLICATION XII
New Frontiers in Multifunctional Material Science and Processing

Serbian Ceramic Society
Institute of Technical Sciences of SASA
Institute for Testing of Materials
Institute of Chemistry Technology and Metallurgy
Institute for Technology of Nuclear and Other Raw Mineral Materials
Institute of General and Physical Chemistry

PROGRAM AND THE BOOK OF ABSTRACTS

Serbian Academy of Sciences and Arts, Kneza Mihaila 35
Serbia, Belgrade, 18-20. September 2024.

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Dear colleagues and friends,

We have great pleasure to welcome you to the Advanced Ceramic and Application XII Conference organized by the Serbian Ceramic Society in cooperation with the Institute of Technical Sciences of SASA, Institute of Chemistry Technology and Metallurgy, Institute for Technology of Nuclear and Other Raw Mineral Materials, Institute for Testing of Materials and Institute for General and Physical Chemistry.

We are very proud that we succeeded in bringing the scientific community together again and fostering the networking and social interactions around an interesting program on emerging advanced ceramic topics. The chosen topics cover contributions from fundamental theoretical research in advanced ceramics, computer-aided design and modeling of new ceramics products, manufacturing of nano-ceramic devices, developing of multifunctional ceramic processing routes, etc.

Traditionally, ACA Conferences gather leading researchers, engineers, specialists, professors and PhD students trying to emphasize the key achievements which will enable the widespread use of the advanced ceramics products in the High-Tech industry, renewable energy utilization, environmental efficiency, security, space technology, cultural heritage, etc.

Serbian Ceramic Society was initiated in 1995/1996 and fully registered in 1997 as Yugoslav Ceramic Society. Since 2009, it has continued as the Serbian Ceramic Society in accordance with Serbian law procedure. Serbian Ceramic Society is almost the only one Ceramic Society in South-East Europe, with members from more than 20 Institutes and Universities, active in 9 sessions. Thanks to all of you for being with us here at ACA XII.

Dr. Nina Obradović
President of the Serbian Ceramic Society

Dr. Suzana Filipović
President of the General Assembly of the Serbian Ceramic Society

Conference Topics

- Basic Ceramic Science & Sintering
- Nano-, Opto- & Bio-ceramics
- Modeling & Simulation
- Glass and Electro Ceramics
- Electrochemistry & Catalysis
- Refractory, Cements & Clays
- Renewable Energy & Composites
- Amorphous & Magnetic Ceramics
- Heritage, Art & Design

Conference Programme Chairs:

Dr. Nina Obradović
Dr. Lidija Mančić

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Institut za tehnologiju nuklearnih i drugih mineralnih sirovina

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Serbian Academy of Sciences and Arts
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Hotel Palace

Република Србија
МИНИСТАРСТВО НАУКЕ,
ТЕХНОЛОШКОГ РАЗВОЈА И
ИНОВАЦИЈА

Conference Program and Abstracts

Program and Abstract's Contents

The Twelfth Serbian Ceramic Society Conference "Advanced Ceramics and Application"

Conference Information:

Conference location: Belgrade (Beograd) – the capital of Serbia, Serbian culture, education, science and economy, having about 2.5 million habitants. Belgrade is situated in South-Eastern Europe, on the Balkan Peninsula, at the confluence of the Sava and Danube Rivers in north-central Serbia. The official language is Serbian, while foreigners can use English.

Conference venue: Serbian Academy of Sciences and Arts - SASA, Great Hall (2nd floor) and Hall2 (1stfloor), Kneza Mihaila 35, Belgrade, Serbia.

Dress code: Serbian Academy of Science and Arts is a distinguished institution of supreme national importance. We kindly ask you to respect a dress code and not to wear short skirts and pants (above the knee); tank top and sleeveless shirts; flip-flops and open-toed sandals.

Conference fee: Standard fee for foreign participants: 400 EUR; Standard fee for domestic participants: 12000 RSD; **Discounts**: Members of SCS, Invited lecturers and PhD Students: 50%; Plenary lecturers& the last year winners (oral and poster presentations): Free of charge.

Invoice and bank details for Conference fee payment: Banka Intesa ad Beograd, Account No. 160-380150-55, notification: Conference fee – participant name.

Paying for the conference fee and Gala dinner at site will be available only in cash

Registration:

18.09.2024. (8.00-9.00 A.M.-2nd Floor) & 19-20.09.2024 (8.00-9.00 A.M.–1st Floor)

Posters installation:

18.09.2024. (16.00-16.30) &19.09.2024. (8.00-9.00) Club SASA

After each session, participants should remove their posters!

Useful telephone numbers:

Police:192

Firemen:193

Ambulance:194

Taxi services: For the taxi services from Belgrade Nikola Tesla Airport to any destination in Belgrade area and further, please contact TAXI INFO desk, located in the baggage area.

Time zone: Belgrade and Serbia are located in the Central European time zone region GMT + 1

Electricity: The electricity voltage in Belgrade is 220V. Electrical outlets are standard EU.

Currency: The official currency in Serbia is dinar, abbreviated RSD. Money may be exchanged in all banks and authorized exchange offices. Exchange rate for 1 EUR is around 118 RSD. Cash

may be taken from ATMs 24 hours a day. Credit cards are accepted in shops, hotels and restaurants.
Water: Tap water in Belgrade is safe to drink.

Abstracts and papers publication: The official language of the conference is English.
Conference abstracts will be published in the **Book of Abstracts**.

Limited number of papers presented at the conference will be possible to publish in **Science of Sintering** and **Tribology and Materials.**

Type of presentation: Visuals for oral presentations should be in Microsoft PowerPoint (.ppt or .pptx) or Adobe Acrobat Reader 9 (.pdf). Any animation or video files must be compatible with Windows 7 and Windows Media Player. Bring your presentation to speaking desk at the beginning of the day when your presentation will be. Posters should be prepared in dimension: 70x100 cm. The official language on conference is English.

Additional Conference information president@serbianceramicsociety.rs
http://www.serbianceramicsociety.rs/about.htm

Recommended places near the Conference venue:

Hotel: Hotel Palace, Topličin venac 23; http://www.palacehotel.co.rs/

Exchange office: „Hulk“, Vuka Karadžića 4

Tourist Information Centre: Kneza Mihaila 5, http://www.tob.rs/en

Date	Time	Programme	Floor, Room, Address
18th September Wednesday	08.00-09.00	**Registration**	2nd Floor, Hallway
	09.00-09.30	**Opening Ceremony**	2nd Floor, Great Hall
	09.30-10.00	**Academician S. Vukosavic (PL)**	
	10.00-10.15	**Award, Photo session & Short break**	
	10.15-12.10	**Modelling & Simulation (M. Mirkovic)** S. Curtarolo (PL) S. Tidrow (PL) J. Jovanovic (INV) N. Milosavljevic (INV) I. Trajkovic (ORL)	
	12.10-12.30	**Coffee Break**	2nd Floor, Hallway
	12.30-14.15	**Nano, Opto & Bio-ceramics (L. Mancic & S. Markovic)** M. E. Rabanal (PL) M. Pergal (INV) J. Purenovic (INV) I. Stojkovic Simatovic (INV) Z. Stojanovic (OR)	2nd Floor, Great Hall
	14.15-15.00	**Buffet Lunch**	Club SASA, Mezzanine
	15.00-16.30	**Amorphous & Magnetic (N. Mitrovic & V. Paunovic)** N. Novosel (PL) N. Mitrovic (INV) D. Olcan (INV) M. Mirkovic (INV & exhibition announcement)	2nd Floor, Great Hall
	16.30-18.30	**Poster Session I & Exhibition ***	Club SASA, Mezzanine
	19.00-23.00	**Conference dinner**	Restaurant Caruso (Terazije 23/8)
19th September Thursday	08.00-09.00	**Registration**	1st Floor, Hallway
	09.00-10.00	**Poster Session II****	Club SASA, Mezzanine
	10.00-12.00	**Basic Ceramics & Sintering (S. Filipovic)** G. Hilmas (PL) W. Fahrenholtz (PL) I. Brceski (PL) A. Peles Tadic (OR) M. Dujovic (OR)	1st Floor, Blue Hall
	12.00-12.30	**Coffee Break**	1st Floor, Hallway
	12.30-13.45	**Basic Ceramics & Sintering (D. Kosanovic & N. Labus)** R. Naraparaju (INV) V. Paunovic (INV) S. Filipovic (INV) S. Smith (OR)	1st Floor, Blue Hall
	13.45-15.00	**Buffet Lunch**	Club SASA, Mezzanine
	15.00-16.20	**Clay, Refractory & Cements (A. Terzic & M. Vasic)** A. Sedmak (PL) G. Tavcar (PL) N. Mijatovic (INV)	1st Floor, Blue Hall
	16.20-17.00	**Coffee Break**	1st Floor, Hallway
	19.00-20.00	**Nikola Tesla Museum**	Krunska 51

***16.00-16.30 Poster Session I (Posters 1-25) Installation Club SASA, Mezzanine**

**** 8.30-09.00 Poster Session II (Posters 26-50) Installation Club SASA, Mezzanine**

20th September Friday	**08.00-09.00**	**Registration**	1st Floor, Hallway
	09.00-11.30	**Renewable Energy & Composites (M. Marceta Kaninski)** A. Savic (PL) Z. Khan (PL) N. Pop (PL) V. Radmilovic (INV) B. Rajcic (INV) D. Khamari (INV)	1st Floor, Blue Hall
	11.30-12.00	**Coffee Break**	1st Floor, Hallway
	12.00-13.00	**Renewable Energy & Composites (D. Milovanovic)** S. Maslovara (INV) B. Stankov (INV) S. Blagojevic (INV)	1st Floor, Blue Hall
	13.00-14.00	**Buffet Lunch**	Club SASA, Mezzanine
	14.00-15.40	**Electrocemistry & Catalysis (M. Pagnacco & M. Vujkovic)** R. Dominko (PL) Z. Jovanovic (PL) E. Fuglein (INV) N. Gavrilov (INV)	1st Floor, Blue Hall
	15.40-16.00	**Coffee Break**	1st Floor, Hallway
	16.00-16.55	**Electrocemistry & Catalysis (M. Pagnacco & M. Vujkovic)** D. Obradovic (INV) V. Radonjic (INV) M. Pogosova (OR)	1st Floor, Blue Hall
	17.00-18.00	**Awards & Closing ceremony**	1st Floor, Blue Hall

Wednesday, September 18th, 2024.

08.00 – 09.00	**Registration**	**Hallway, 2nd Floor**
		Great Hall, 2nd Floor
09.00 – 10.00	**Opening Ceremony of the XII Serbian Ceramic Society Conference: Advanced Ceramics and Application XII** **President of SCS – Dr. Nina Obradović, Short music program, Dr. Marina Soković – Representative of Ministry for Science, Award Ceremony–** **PL New materials in electrical grids and power industry** Academician Slobodan Vukosavić
10.00 - 10.15	**Short break and Photo Session**	
		Great Hall, 2nd Floor
10.15 – 12.10	**Modelling & Simulation** **Chairperson: Miljana Mirkovic**
10.15 – 10.45	**PL From BIG-data to HOT-properties of high-entropy carbides and carbo-nitrides** Stefano Curtarolo, Edmund T. Pratt Materials Science, Electrical Engineering and Physics, Center for Extreme Materials, Duke University, USA
10.45 – 11.15	**PL New Simple Material Model and Extension to Rock Salt, $Fm\bar{3}m$ Structure** Steven C. Tidrow New York State College of Ceramics at Alfred University, 1 Pine Street Alfred, NY, USA 14802
11.15 – 11.35	**INV The effect of zeolite type and concentration on thermal and mechanical properties of zeolite-poly(methacrylic acid) composite hydrogels** Jelena D. Jovanovic[1], Vesna V. Panic[2], Nebojsa N. Begovic[1], Borivoj K. Adnadjevic[3] [1]Institute for General and Physical Chemistry, Studentski Trg 12-16/V 11158 Belgrade, Serbia [2]University of Belgrade, Innovation Center of Faculty of Technology and Metallurgy, 4 Karnegijeva Street, 11000 Belgrade, Serbia [3]Faculty of Physical Chemistry, University of Belgrade, Studentski Trg 12-16, 11158 Belgrade, Serbia
11.35 – 11.55	**INV The power of machine learning** Nataša Milosavljević Faculty of Agriculture, University of Belgrade

11.55 – 12.10 **ORL Development of a numerical procedure for assessing the fracture resistance of materials for pressure pipelines using the ring specimens**

Isaak Trajković[1], M. Milošević[1], J. Tanasković[2], Z. Radosavljević[3], B. Međo[4]
[1]Innovation center of faculty of Mechanical Engineering in Belgrade, Kraljice Marije 16, 11000 Belgrade, Serbia
[2]University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, 11000 Belgrade, Serbia
[3]Research and Development Institute Lola, Kneza Višeslava 70a, Belgrade, Serbia
[4]University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia

12.10 – 12.30 **Coffee Break** **Hallway, 2nd Floor**

Great Hall, 2nd Floor

12.30 – 14.15 **Nano, Opto & Bio-ceramics**
Chairpersons: Lidija Mančić & Smilja Marković

12.30 – 13.00 **PL The wonderful challenges of Nanomaterials**

A. Ferreiro[1], L. Gomez-Villalba[2], Dwight Acosta[3], P. Fernández[4], O. Milosevic[5], Maria E. Rabanal[1]
[1]Carlos III University and IAAB, High School of Engineering, Avenida de la Universidad s/n, 28911- Leganes, Spain.
[2]Institute of Geociencias-CSIC-UCM, Calle del Dr.Severo Ochoa 7, 28040-Madrid
[3]Universidad Nacional Autónoma de Mexico. Institute of Physics (UNAM)
[4]Complutense University, Facultad Ciencias Físicas, Cuidad Universitaria, Plaza Ciencias 1, 28040-Madrid, Spain
[5]Institute of Technical Sciences of Serbian Academy ad Arts, Belgrade, Serbia

13.00 – 13.20 **INV Poly(dimethylsiloxane)-based polyurethanes and nanocomposites for biomedical and electronic applications**

Marija V. Pergal
Center of Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia, University of Belgrade, Njegoševa 12, 11000 Belgrade, Serbia

13.20 – 13.40 **INV Novel multifunctional electrochemically active microalloyed composite and nanomaterials, with accompanying scientific discoveries of processes, morphologies and solid-state active contact phenomena**

Jelena Purenović
University of Kragujevac, Faculty of Technical Sciences Čačak
Svetog Save 65, 32000 Čačak, Serbia

13.40 – 14.00 **INV V_2O_5-based nanostructured powders as a cathode material for post-lithium aqueous batteries**
Ivana Stojković Simatović
University of Belgrade - Faculty of Physical Chemistry, Studentski trg 12-16, Belgrade, Serbia

14.00 – 14.15 **ORL AI aided biomaterials research: stabilization of selenium nanoparticles with proteins**
Zoran Stojanović, Nenad Filipović, Magdalena Stevanović
Institute of Technical Sciences of SASA, Belgrade, Republic of Serbia

14.15 - 15.00 **Buffet Lunch** **Club SASA**

Great Hall, 2nd Floor

15.00 – 16.30 **Amorphous & Magnetic**
Chairpersons: Nebojša Mitrović & Vesna Paunović

15.00- 15.30 **PL Exotic magnetic and transport phenomena in strongly correlated ceramic materials**
Nikolina Novosel
Institute for physics, Bijenička cesta 46, 10000 Zagreb, Croatia

15.30 - 15.50 **INV Magnetically soft and semi-hard materials**
Nebojša Mitrović[1], Borivoje Nedeljković[1], Nina Obradović[2], Jelena Orelj[1], Sanja Aleksić[3], Vladimir Pavlović[4]
[1]Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Systems, Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia,
[2]Institute of Technical Sciences, Serbian Academy of Sciences and Arts, Belgrade, Serbia
[3]University of Niš, Faculty of Electronic Engineering, Niš, Serbia
[4]University of Belgrade, Faculty of Agriculture, Belgrade, Serbia

15.50 – 16.10 **INV Measurement of dielectric and magnetic properties of ceramic materials**
Antonije Đorđević[1,2], Dragan Olćan[1]
[1]School of Electrical Engineering, University of Belgrade, Bulevar kralja Aleksandra 73, 11120 Belgrade, Serbia
[2]Serbian Academy of Sciences and Arts, Belgrade, Serbia

16.10 – 16.30 **INV Hydroxyapatite and hydroxyapatite-cellulose composite materials as functional ingredients in cosmetic products**
Miljana Mirković[1], Marko Perić[2], Aleksandra Sknepnek[3], Dunja Miletić[3], Vladimir Pavlović[3], Aleksandra Rašović[4], Marija Šuljagić[5]

[1]Department of Materials, "Vinča" Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia
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[4]Aleksandra Rašović PR AMELLES, Žarka Zrenjanina 43, 36210 Vrnjačka Banja, Srbija
[5]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia, Belgrade, Serbia

16.30 – 18.30	**Poster Session I & Exhibition**	**Club SASA**
19.00 – 23.00	**Conference dinner**	**Restaurant Caruso**

Thursday, September 19th, 2024.

Hallway, 1st Floor

08.00 – 09.00	**Registration**
09.00 –10.00	**Poster Session II** **Club SASA**

Blue Hall, 1st Floor

10.00 – 12.00	**Basic Ceramics & Sintering** **Chairperson: Suzana Filipović**
10.00 – 10.30	**PL Ultrahigh Temperature Fuel Forms for Nuclear Thermal Propulsion** Gregory E. Hilmas Missouri University of Science and Technology, Department of Materials Science and Engineering, 222 McNutt Hall; 1400 N. Bishop Avenue, Rolla, MO 65409, United States
10.30 – 11.00	**PL Thermodynamic Analysis of Dual-Phase High Entropy Ceramics** William G. Fahrenholtz[1], Steven M. Smith II[1], Gregory E. Hilmas[1], Stefano Curtarolo[2] [1]Materials Science and Engineering Department Missouri University of Science and Technology Rolla, MO 65409 United States [2]Center for Extreme Materials and Department of Mechanical Engineering and Materials Science Duke University Durham, NC 27708 United States
11.00 – 11.30	**PL Ceramic and Rare Earth Elements** Ilija Brčeski[1,2] [1]Faculty of Chemistry, University of Belgrade, Studentski trg 12-16, Belgrade [2]European Academy of Sciences and Arts, St. Peter-Bezirk 10, Salzburg, Austria
11.30 – 11.45	**ORL The influence of mechanical activation parameters as a function of producing a Magnesium aluminate ($MgAl_2O_4$) spinel** A. Peleš Tadić[1], J. Živojinović[1], S. Marković[1], N. Tadić[2], S. M. Lević[3], V. Pavlović[3], S. Filipović[1], N. Obradović[1] [1]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, 11000 Belgrade, Serbia [2]University of Belgrade, Faculty of Physics, 11000 Belgrade, Serbia [3]University of Belgrade, Faculty of Agriculture, 11080 Belgrade, Serbia
11.45 – 12.00	**ORL Anisotropic Cracking and Lack Thereof in MAX Phases** Miloš Dujović, Sahin Celik, Ankit Srivastava, Miladin Radović Department of Materials Science and Engineering, Texas A&M University, College Station, TX 77843, USA

12.00 – 12.30	**Coffee Break**	**Hallway, 1st Floor** **Blue Hall, 1st Floor**

12.30 – 13.45	**Basic Ceramics & Sintering** **Chairpersons: Darko Kosanović & Nebojša Labus**

12.30 – 12.50 **INV Development of oxidation protective coatings on ZrB_2 based UHTC materials using magnetron sputtering method**

Ravi Naraparaju, J. E. Förster
Institute of Materials Research, German Aerospace Center, Cologne, Germany

12.50 – 13.10 **INV Effects of rare earth ions doping on microstructure and electrical properties of barium titanate ceramics**

Vesna Paunović, Zoran Prijić
University of Niš, Faculty of Electronic Engineering, Aleksandra Medvedeva 14, 18000 Niš, Serbia

13.10 – 13.30 **INV Synthesis and Properties of (Hf,Mo,Ti,W,Zr)B_2–(Hf,Mo,Ti,W,Z)C Dual Phase Ceramics**

S. Filipović[1,2], Steven M. Smith II[1], G. Hilmas[1], W. Fahrenholtz[1], N. Obradović[2], S. Curtarolo[3]
[1]Materials Science and Engineering, Missouri University of Science and Technology, 65049 Rolla, Missouri, United States
[2]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, 11000 Belgrade, Serbia
[3]Center for Extreme Materials, Duke University, 27708 Durham, USA

13.30 – 13.45 **ORL Densification and Properties of High Entropy Boride-SiC-B_4C Ceramics**

Steven M. Smith[1], William G. Fahrenholtz[1], Gregory E. Hilmas[1], Stefano Curtarolo[2,3]
[1]Missouri University of Science and Technology, Rolla, MO, USA
[2]Duke University, Department of Mechanical Engineering and Materials Science, Durham, NC, USA
[3]Duke University, Center of Autonomous Materials Design, Durham, NC, USA

13.45 – 15.00	**Buffet Lunch**	**Club SASA** **Blue Hall, 1st Floor**

15.00 – 17.20	**Clay, Refractory & Cements** **Chairpersons: Anja Terzić & Milica Vasić**

15.00 – 15.30 **PL Structural integrity aspects of historical stone constructions**

Aleksandar Sedmak[1], Simon Sedmak[2]

[1]University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, Belgrade, Serbia
[2]Innovation Center of the Faculty of Mechanical Engineering, Kraljice Marije 16, Belgrade, Serbia

15.30 – 16.00 **PL Zero waste reprocessing of EAF dust – EIT RIS DustRec project**

Gašper Tavčar[1], Davide Mombelli[2], Dragan Radulović[3], Ivica Ristović[4], Mateusz Ciszewski[5], Jasna Kastivnik[6], Ana Mladenovič[7], Alenka Mauko[7]
[1]Jožef Stefan Institute, Department of Inorganic Chemistry and Robert Kocjančič - Jožef Stefan Institute, Department of Inorganic Chemistry and Technology, Jamova 39, SI-1000 Ljubljana, Slovenija
[2]Carlo Mapelli, Gianluca Dall'Osto – Politecnico di Milano, Dipartimento di Meccanica, Via La Masa 1, I-20156 Milano, Italy
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[6]TH ReMining, Dunajska cesta 156, SI-1000 Ljubljana, Slovenia
[7]Slovenian National Building and Civil Engineering Institute (ZAG), Dimičeva ulica 12, SI-1000 Ljubljana, Slovenia

16.00 – 16.20 **INV The Evolution of Chemical Analysis in the Construction Industry: Adapting Methodology to New Eco-Friendly Materials**

Nevenka Mijatović
Institute for Materials Testing, Bulevar vojvode Mišića 43, 11000 Belgrade, Serbia

16.20 – 17.00 **Coffee Break** **1st Floor, Hallway**

19.00 – 20.00 **Nikola Tesla Museum** **Krunska 51**

Friday, September 20th, 2024.

08.00 – 09.00	**Registration**	**Hallway, 1st Floor**
		Blue Hall, 1st Floor
09.00 – 11.30	**Renewable Energy & Composites** **Chairperson: Milica Marčeta Kaninski**	
09.00 – 09.30	**PL Porous concrete pavement development with respect to the waste materials and flood control** Aleksandar R. Savić, Marina Škondrić, Ognjen Govedarica University of Belgrade Faculty of Civil Engineering, Belgrade, Serbia	
09.30 – 10.00	**PL Experimental and numerical analysis of heat transfer performance of composites in clean energy systems** Zulfiqar A. Khan NanoCorr, Energy & Modelling (NCEM) Research Group, Department of Design & Engineering, Bournemouth University, Dorset, Poole, UK	
10.00 – 10.30	**PL From solar energy to molecular energetics** Nicolina Pop Fundamentals of Physics for Engineers Department, Research Center on Advanced Methods for the Study of Physical Phenomena Politehnica University of Timisoara, Romania	
10.30 – 10.50	**INV Silver Linings: Nanowires in Optoelectronics** Vuk V. Radmilović[1], Jovan Lukić[1], Velimir R. Radmilović[2] [1]Faculty of Technology and Metallurgy, University of Belgrade, Serbia [2]Serbian Academy of Sciences and Arts, Belgrade, Serbia.	
10.50 – 11.10	**INV Comparative structural analysis of M-doped (M = Ru, Sb, Ni, Co) TiO_2 as support materials in Pt-based catalysts for application in fuel cells** Boris Rajčić[1], Slađana Maslovara[1], Dubravka Milovanović[1], Milica Marčeta Kaninski[1], Vladimir Nikolić[1], Janez Kovač[2], Zoran Šaponjić[1] [1]Institute of General and Physical Chemistry, Studentski trg 12/V, Belgrade, Serbia [2]Jožef Stefan Institute, Jamova Cesta 39, Ljubljana, Slovenia	
11.10 – 11.30	**INV Linear Parameter Varying sensorless Torque Control for Singularly Perturbed photovoltaic pumping system with Torque and Flux observers** Dalila Khamari[1], Idriss Benlaloui[2], Sabir Ouchen[3], Larbi Chrifi-Alaoui[4] [1]LSTE Laboratory, Electrical Engineering Department; University of Batna2, Algeria.	

[2]Université 8 mai 1945, Guelma, Algeria.
[3]PowerElectronics and Electrical Drives Laboratory Aalen University, Germany.
[4]University of Picardie Jules Verne, Cuffies, France.

11.30 – 12.00	**Coffee Break**	**Hallway, 1st Floor**

12.00 – 13.00	**Renewable Energy & Composites** **Chairperson: Dubravka Milovanović**
12.00 – 12.20	**INV Utilizing NiFeMo based ionic activators in alkaline electrolysis: A combination of experimental and theoretical methods** Slađana Maslovara[1], Dragana Vasic Anicijevic[2],Mihajlo Mudrinic[1], Milica Marčeta Kaninski[1], Vladimir Nikolić[1] [1]Institute of General and Physical Chemistry, Studentski trg 12/V, Belgrade, Serbia [2]Vinca Institute of Nuclear Science, University of Belgrade, Mike Petrovica Alasa 12-14, Belgrade, Serbia
12.20 – 12.40	**INV Spectroscopic Analysis of Beryllium Ceramics** Biljana D. Stankov Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia
12.40 – 13.00	**INV HEMP COMPOSITES: A Sustainable Alternative for Advanced Material Applications** Stevan N. Blagojević Institute of General and Physical Chemistry, Studentski trg 12/V, Belgrade, Serbia

13.00 – 14.00	**Buffet lunch**	**Club SASA** **Blue Hall, 1st Floor**

14.00 – 15.40	**Electrocemistry & Catalysis** **Chairpersons: Maja Pagnacco & Milica Vujković**
14.00 – 14.30	**PL Interfacial stability of NMC materials** Robert Dominko[1,2,3], Blaž Jaklič[4,5], Jan Žuntar[4,5], Elena Tchernychova[1], Gregor Kapun[1], Rekha Narayan[1], Matjaž Spreitzer[4] [1]National Institute of Chemistry, Hajdrihova ulica 19, 1000 Ljubljana, Slovenia [2]Faculty of Chemistry and Chemical Technology, University of Ljubljana, Večna cesta 13, 1000 Ljubljana, Slovenia [3]Alistore-European Research Institute, CNRS FR 3014, Hub de l'Energie, Rue Baudelocque, 80039, Amiens, France [4]Advanced Materials Department, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia

[5]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia

14.30 – 15.00 **PL PLD growth of functional oxides on Silicon substrate using various template techniques**

Zoran Jovanovic[1,2], Urška Trstenjak[2], Binbin Chen[3], Gertjan Koster[4], Matjaž Spreitzer[2]
[1]Laboratory of Physics, Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia
[2]Advanced Materials Department, Jožef Stefan Institute, Ljubljana, Slovenia
[3]Key Laboratory of Polar Materials and Devices (MOE) and Department of Electronics, East China Normal University, 200241 Shanghai, China
[4]MESA+ Institute for Nanotechnology, University of Twente, Enschede, The Netherlands

15.00 – 15.20 **INV About the Dehydration of Lanthanum Hydroxide – Reaction Mechanism and its Kinetic Studies**

Ekkehard Füglein[1], Dirk Walter[2]
[1]NETZSCH-Gerätebau GmbH, Wittelsbacherstraße 42, D-95100 Selb, Germany
[2]Gefahrstofflaboratorien Chemie und Physik am Institut für Arbeits- und Sozialmedizin der Justus-Liebig-Universität, Aulweg 129, D-35392 Gießen

15.20 – 15.40 **INV Niobium MXenes: promising materials for applications in energy conversion and storage**

Nemanja Gavrilov[1], Meriene Gandara[2], Biljana Šljukić Paunković[1], Emerson Sarmento Gonçalves [2,3]
[1]University of Belgrade, Faculty of Physical Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia
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[3]Institute of Aeronautics and Space, Divisão de Materiais, Praça Marechal Eduardo Gomes, 50 e 12228-904, São José dos Campos, Brazil

15.40 – 16.00 **Coffee Break** **1st Floor, Hallway**

16.00 – 16.55 **Electrochemistry & Catalysis**
Chairpersons: Maja Pagnacco & Milica Vujković

16.00 – 16.20 **INV Physicochemical and biomimetic information for evaluating compound quality**

Darija Obradović, Saša Lazović
Institute of Physics Belgrade, National Institute of the Republic of Serbia, Pregrevica 118, 11080 Belgrade, Serbia

16.20 – 16.40 **INV Use of perlite as nickel catalyst support in sunflower oil hydrogenation process**

Vojkan D. Radonjić[1], Dimitrinka Nikolova[2], Margarita Gabrovska[2], Jugoslav B. Krstić[1]
[1]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia
[2]Institute of Catalysis, Bulgarian Academy of Sciences, Sofia 1113, Bulgaria

16.40 – 16.55 **ORL Crystal Structure Monitoring - New Insights into the Familiar Ion-Conductive Ceramics**

Mariam Pogosova, Dominic Bresser
Helmholtz-Institut Ulm, Helmholtzstraße 11, 89081 Ulm, Germany

17.00 – 18.00 **Awards & Closing Ceremony** **Blue Hall, 1st Floor**

Book of Abstracts

PL1

New materials in electrical grids and power industry

Slobodan Vukosavic

Serbian Academy of Sciences and Arts, Kneza Mihaila 35, 11000 Belgrade, Serbia

In the field of AC grids and electric power industry, there are significant changes that are creating the need for new materials. Transmission and distribution grids change topology and become ever more decentralized. Spatially close consumers, sources and storage facilities are often grouped together and they independently decide on their transactions with the grid. An increasing share of consumers and sources is connected to the network via power electronics devices, energy converters which transform and adjust voltages and currents for efficiency, safety and functionality. Advantages of direct currents in transmission and distribution grids, as well as the fact that an increasing number of consumers use DC electricity leads to an increasing use of DC grids. The mentioned changes are connected with the need of devising new topologies, systems and devices that largely depend on new materials.

PL2

From BIG-data to HOT-properties of high-entropy carbides and carbo-nitrides

Stefano Curtarolo, Edmund T. Pratt

Materials Science, Electrical Engineering and Physics, Center for Extreme Materials,
Duke University, USA

Disordered multicomponent systems - occupying the mostly uncharted centers of phase diagrams - have been studied for the last two decades for their potential revolutionary properties [1]. Very resilient compositions can be stabilized by maximizing entropy (configurational and/or vibrational) of (near) equimolar mixtures [2]. The search for new systems is mostly performed with trial-and-error techniques, as effective computational discovery is challenged by the immense number of configurations [3]: the synthesizability of high-entropy ceramics is typically assessed using ideal entropy along with the formation enthalpies from density functional theory, with simplified descriptors [4,5,6] or machine learning methods [7]. With respect to vibrations — even if they may have significant impact on phase stability — their contributions are drastically approximated to reduce the high computational cost, or often avoided with the hope of them being negligible, due to the technical difficulties posed in calculating them for disordered systems [8]. In this presentation I will address many of the problems in the discovery of disordered systems, offer some data-based effective solutions, and discuss the avenues opened by the latter, especially for plasmonic-hyperbolic applications [9]. [1] Nat. Rev. Mater. **5**, 295 (2020); [2] Nat. Comms **6**, 8485 (2015); [3] npj Comput. Mater. **5**, 69 (2019); [4] Nat. Comms **9**, 4980 (2018); [5] Acta Mater. **159**, 364 (2018); [6] Nature ***625**, 66 (2024)*; [7] Nat. Rev. Mater. **6**, 730 (2021); [8] Nat. Comms **12**, 5747 (2021). [9] *Nat. Comms **13**, 5993 (2022).*

PL3

New Simple Material Model and Extension to Rock Salt, $Fm\bar{3}m$ Structure

Steven C. Tidrow

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Goldschmidt's tolerance factor formalism (GTFF), a correlation relation, has led the development of perovskites for nearly one-hundred years. Unfortunately, GTFF indicates that about 90%, while less than 15%, of all potential "simple" ABC_3 materials form perovskites. Ultimately, GTFF is worse than the use of the coin-flip method for identifying whether a potential perovskite, ABC_3, will form or not; yet, is extensively used. On-the-other-hand, the new "simple" material model (NSMM), based on physical constraints, identifies 90% and 70% of those materials that form and do not form the perovskite structure, respectively. The superior performance of NSMM over GTFF is demonstrated through mapping roughly 2500 "simple" halide and some additional "simple" chalcogenide perovskites into normalized ionic radii space and comparing which form and do not form perovskites. Additionally, NSMM is extended to include the "simple", two-component, rock salt, $Fm\bar{3}m$, structure, through mapping roughly 450 potential "simple" halide compositions into ionic radii space and identifying those that form and do not form the $Fm\bar{3}m$ structure. Whence, NSMM, through excel spreadsheet, is a fast, relatively powerful method that is extensible to additional material systems; reasonably identifying which materials will and will not form, predicting lattice parameter/volume, and some temperature dependent phase transitions.

PL4

The wonderful challenges of Nanomaterials

A. Ferreiro[1], L. Gomez-Villalba[2], Dwight Acosta[3], P. Fernández[4],
O. Milosevic[5], Maria E. Rabanal[1]

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Nanomaterials deserve special attention because they represent a class of materials that enhance structural and functional properties compared to bulk materials. These nanomaterials have emerged as substances with at least one dimension within the 1 to 100 nm range. They can be categorized based on their properties, shapes (0D, 1D, 2D, or 3D), or sizes. Due to their high surface area and nanoscale dimensions, nanomaterials exhibit distinctive physical and chemical properties. They can exhibit remarkable magnetic, electrical, optical, mechanical, and catalytic characteristics that significantly differ from their bulk counterparts. Notably, their optical properties are size-dependent, resulting in various colors due to absorption in the visible region.

Additionally, their unique size, shape, and structure influence their reactivity, toughness, and other attributes. In summary, nanomaterial properties can be fine-tuned by controlling factors such as size, shape, synthesis conditions, and appropriate functionalization. We will review nanomaterials' past, present, and future during the presentation. Drawing from our recent research in this field, we will highlight significant milestones achieved through collaboration with international research centers. Topics of discussion will include semiconductor systems (such as ZnO, TiO_2, Fe_2O_3, Fe_3O_4…), luminescent nanomaterials (such as Gd_2O_3, Eu_2O_3,…), single-wall and multi-wall carbon nanotubes, and various other "exotic" materials due to their small size.

PL5

Exotic magnetic and transport phenomena in strongly correlated ceramic materials

Nikolina Novosel

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The synthesis and investigation of novel materials with unconventional electronic and magnetic properties have become one of the foremost areas of research in condensed matter physics. Among these, strongly correlated electron systems stand out due to the many new phenomena arising from complex interactions between electrons, such as high-temperature superconductivity, charge and spin ordering, exotic electric transport, and multiferroicity. The theoretical study of these systems is highly demanding as they involve many-body interactions with a fine interplay between charge, spin, lattice and orbital degrees of freedom. Moreover, experimental work on strongly correlated systems has proven to be equally challenging as their most intriguing properties often emerge under extreme conditions of very low temperature, high magnetic field, and high pressure.

In this lecture I will focus on one of the typical examples of strongly correlated electron systems: manganites. Manganese oxides or manganites with general chemical formula $R_{1-x}A_xMnO_3$, where R is a trivalent rare earth element or bismuth and A is a divalent alkaline earth element or lead, attracted enormous attention of scientific community with the discovery of colossal magnetoresistance (CMR) – a metal-insulator transition caused by a magnetic field at the temperature close to the Curie point. CMR stems from complex interactions between electrons and crystal lattice deformations which also give rise to a very rich phase diagram with temperature and chemical composition of manganites showing complex conducting properties, charge ordering, various magnetic ordering, and phase separation. Despite several decades of intensive research manganites continue to present new challenges for fundamental study of physical properties and opportunities for potential applications.

PL6

Ultrahigh Temperature Fuel Forms for Nuclear Thermal Propulsion

Gregory E. Hilmas

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New methods for the fabrication of compositions for nuclear thermal propulsion (NTP) fuel forms are desired for extreme environment applications in the space industry. Current NTP fuel forms commonly consist of carbides or cermets based on ultra-high temperature ceramics (UHTCs) or UHTCs and a refractory metal, respectively. Current research is focused on near net shape fabrication using surrogate fuel form compositions, as working with radioactive materials presents a significant processing challenge. This study consists of sintering/densification of a ZrC-Mo cermet and ZrC-NbC composites systems, wherein ZrC or NbC act as a surrogate for UC, and includes optimization of the fabrication process for producing complex fuel form geometries and measurements of material property data. Commercially available powders of ZrC and Mo were batched with 60:40 vol% ratio for the cermet, and ZrC and NbC powders were batched with 50:50 vol% ratio for the UHTC. Powder batches were ball milled with a 2 wt% organic binder superaddition, dried via rotary evaporation, and spark plasma sintered to produce dense billets. The dense compositions were characterized to determine microstructure as well as thermal and mechanical properties. Finally, more complex NTP geometries, including fuel forms with integral cooling channels, were spark plasma sintered to demonstrate near net shape fabrication.

PL7

Thermodynamic Analysis of Dual-Phase High Entropy Ceramics

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The present work aimed to develop a thermodynamic model to predict the segregation behavior of metals in dual phase ceramics. Dual phase high entropy ceramics contain both a high entropy boride and a high entropy carbide. Previous research has shown that some transition metals in dual phase high entropy ceramics tend to segregate to either the boride or carbide phase. Typically, Ti and Nb segregate to the boride phase while Hf and Ta segregate to the carbide phase. Sets of binary solution equilibria were analyzed to predict trends in metal segregation. The governing reaction for equilibrium between the boride and carbide phases was defined and the standard Gibbs' free energies of reaction were calculated using FactSage. The relationship between the experimental data and the standard Gibbs' free energy was determined using macroscopic thermodynamic analysis. Energy dispersive spectroscopy was used on dual phase ceramics to measure the metal content of each high entropy phase and the results were compared

to the thermodynamic model. The model was validated by comparing predictions to compositions of dual phase high entropy ceramics reported in published papers.

PL8

Ceramic and Rare Earth Elements

Ilija Brčeski[1,2]

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Technologists use the term "ceramics" mostly to mean all inorganic, non-metallic materials, mainly based on silicon. Chemists refer to solid-state chemistry, introducing additionaltypes: silicon-carbide and nitride, lithium- or thorium-oxide, ferrite... also ceramics with rare-earth elements. Ceramic materials and their properties and applications are limitless. The beginnings of the use of ceramics are linked with those of mankind (from construction to art, ≈30,000 years ago!), with the so-called traditional ceramics, until the present (future) times with "advanced ceramics". Its properties are miraculous, from mechanical (durability, resistance to deformation, fracture, abrasion...), to physical (density, porosity, conductivity), to chemical (stability at high temperatures, corrosion resistance...).
Rare-earth elements (REE) are comprised of lanthanum, lanthanides, scandium and yttrium (Sc,Y,La,Ce,Pr,Nd,Pm,Sm,Eu,Gd,Tb,Dy,Ho,Er,Tm,Yb,Lu). Some are not actually rare (with more of them than gold, silver, tin, lead). The main sources are monazite sands, phosphate sands and other minerals. Their chemical properties (generally in the +3 oxidation state) vary from the pyrophoric cerium, to the inert lutetium. They release hydrogen with water. Their physical properties are also unusual:some are excellent neutron absorbers (Sm,Eu,Gd, better than Cd,B). Their optical properties include luminescence, fluorescence.The "combination" of ceramics with these metals gives highly valuable materials.

PL9

Structural integrity aspects of historical stone constructions

Aleksandar Sedmak[1], Simon Sedmak[2]

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Historical aspects of structural integrity are presented in the case of stone constructions, starting from the Great Pyramids in antient Egypt, going through the centuries and other great civilizations (Parthenon in Athens, Pantheon in Rome and Hagia Sophia in Constantinopolis), with special attention to stone bridges (from the oldest one in Izmir, the caravan bridge from 850 BC, where so-called Roman arch was introduced, to the old stone beautiful bridge in Mostar and and more classical one in Visegrad, strongly resembling destroyed Trajan bridge over Danube). Basis aspects of fracture mechanics and structural integrity in relation to stone are discussed to

explain eternity and beauty of this material and its constructions. This paper is dedicated to the memory of Prof. Stojan Sedmak (1929-2014), one of the fathers of the fracture mechanics in Southeast Europe. Motivation for our research was his paper based on the presentation at the 10th Conference "New Trends in Fatigue and Fracture" in Metz, France, 2010.

PL10

Zero waste reprocessing of EAF dust – EIT RIS DustRec project

Gašper Tavčar[1], Davide Mombelli[2], Dragan Radulović[3], Ivica Ristović[4], Mateusz Ciszewski[5], Jasna Kastivnik[6], Ana Mladenovič[7], Alenka Mauko[7]

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The Electric Arc Furnace (EAF) method is predominantly used for recycling steel scrap, leading to the production of EAF dust at a rate of approximately 10-20 kg per ton of steel. This dust is rich in valuable metals such as iron (Fe) and zinc (Zn), and includes other metal oxides like lead (Pb), manganese (Mn), nickel (Ni), and chromium (Cr). The DustRec project is designed to recover all these elements, offering a comprehensive alternative to the traditional Waelz kiln process, which primarily focuses on zinc recovery. The project employs a combination of magnetic and gravimetric separation techniques to divide selected dust samples into two principal fractions: magnetic and non-magnetic. This classification enables targeted processing of each stream through appropriate pyrometallurgical and hydrometallurgical methods, based on their specific compositions. Throughout the project, various samples were collected from multiple sources, and the two most suitable were chosen for advanced reprocessing. The separation based on particle size resulted in diverse outcomes. The subsequent hydrometallurgical treatment of these fractions yielded substantial recoveries of Zn, Cu, and Pb.

PL11

Porous concrete pavement development with respect to the waste materials and flood control

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In the first two decades of the 21st century, the research of composites with the use of byproduct materials was extensive, induced by global climate changes, disruption of the balance in the environment, and with respect to the sustainable development concept, in the hope that there will be a deviation from the evidently risky and self-destructive global route. The paper presents the development of porous concrete pavement slabs, with byproduct materials as components. The application of such slabs is a consequence of the need for improved control of water from atmospheric precipitation, especially in urban areas. In the composition of these slabs, a spectrum of different component materials was analyzed and tested, with the byproduct material (neutral). Component materials for porous concrete slabs included: aggregates from natural and artificial materials (crushed aggregate and expanded clay), natural river sand, cement with additives, water, chemical admixture and neutral. The tested physical and mechanical properties involved: bulk density, water absorption, compressive and flexural tensile strength, load capacity, frost and salt resistance, and wear resistance. There was a decrease in the mechanical properties and in the durability, with the increase in the content of byproduct material, but with the possibility of their improvement by partial substitution of the component materials with more suitable ones.

PL12

Experimental and numerical analysis of heat transfer performance of composites in clean energy systems

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The aim of this work is to study technological and commercial prospects of metal oxides as nano-Phase Change Materials for latent heat storage applications. Charging and discharging cycles were simulated in a shell-and-tube heat exchanger at controlled temperatures as key methodology. A horizontal shell-and-tube heat exchanger was fabricated with acrylic shell container and stainless-steel tubes. Paraffin based nano metal oxides were employed for this study. Both charging and discharging performance was investigated at varying nano additives proportion. Physical model and computational domain were set by choosing phase change temperature, latent heat fusion, density, thermal conductivity, specific heat capacity and volumetric heat capacity. A significant number of nano additives have been studies of which a selection of fourteen nano additives is presented here in terms of their effective thermal conductivity performance with respect to volume concentration. Time step and grid

independency tests results in terms of liquid fraction are discussed. In conclusion, natural convection has demonstrated a significant influence on nano-PCM melting behavior in a shell container. Peak heat flux showed a corresponding behavior with an increase in volume concentration. An economic evaluation in terms of commercial significance is presented.
Acknowledgments: *This research was supported by the Science Fund of the Republic of Serbia, #7750288, Tailoring Molecular Magnets and Catalysts Based on Transition Metal Complexes – TMMagCat.*

PL13

From solar energy to molecular energetics

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An imperative prerequisite for sizing solar-thermal and photovoltaic systems is the monitoring of the amount of available solar energy. A few meteorological stations worldwide only are equipped to measure the spectral solar irradiance. This motivates the search for a numerical substitute. Therefore, an innovative approach based on a general method has been used to infer the effective atmospheric transmittance. Its illustration resulted in a new parametric model for computing the solar irradiance components and its application to compute solar irradiation.
Photovoltaic cells are prone to thermal degradation in time, therefore they have to be monitored. We have explored a range of testing methods for such a monitoring, including: Scanning Electronic Microscopy (SEM), Atomic Force Microscopy (AFM), Optical Coherence Tomography (OCT), as well as hardness measurements. Two categories of samples are considered for the study: new and used PV cells. The latter have been exposed to various atmospheric conditions for several years, the most significant being the temperature influence. Differences in the structure and properties of the two categories of PVs are assessed using these three methods.
On the other hand boron fluoride (BF_3) containing plasmas are important for applications in the field of material processing. BF_3 and Ar/BF_3 plasmas are used for p-type doping in the semi-conductor industry. BF^+ ion can represent a significant fraction of the ions produced when working at high power density discharge conditions for which BF_3 dissociation and dissociative ionization are strongly enhanced.
Using multichannel quantum defect theory MQDT, cross sections and Maxwell rate coefficients have been obtained for dissociative recombination (DR), vibrational excitation (VE, inelastic collisions), vibrational de-excitation (VdE, super-elastic collisions) for the lowest three vibrational levels of the BF^+ in its ground electronic state.

PL14

Interfacial stability of NMC materials

Robert Dominko[1,2,3], Blaž Jaklič[4,5], Jan Žuntar[4,5], Elena Tchernychova[1], Gregor Kapun[1], Rekha Narayan[1], Matjaž Spreitzer[4]

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$LiNi_{1-x-y}Mn_xCo_yO_2$ (NMC) is a promising class of materials that can be used as cathodes in lithium-ion batteries due to their intrinsic energy storage properties [1]. Each transition metal has a specific role in the composition. A higher nickel content improves energy density but is associated with higher interfacial reactivity. Pulsed laser deposition (PLD) is a great technique for depositing ceramic materials in epitaxial thin films, which has proven valuable for exploring the anisotropic properties of layered materials [2]. By carefully selecting the substrates, one can tune the orientational growth and thus investigate the reactivity of the different exposed surfaces. In the presentation, an overview of NMC interfacial chemistry will be given, focussing on the investigation of how to establish stable and safe electrochemical cycling of NMC materials [3-4]. In the second part, further efforts to understand the reactivity of different surfaces will be discussed based on the results obtained on PLD samples [5].

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PL15

PLD growth of functional oxides on Silicon substrate using various template techniques

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Epitaxial integration of oxides with semiconductor substrates is often limited by the lattice mismatch between the two material systems and their dissimilar chemical properties. As a consequence, the epitaxial growth of functional oxides on silicon requires atomically defined surfaces, which are most effectively prepared using SrO- or Sr-induced deoxidation and passivation. As-prepared surfaces enable overgrowth with various oxides for novel device applications. In most cases, the initial buffer layer is $SrTiO_3$ (STO), acting as a pseudo-substrate. Noteworthy, the quality of the STO depends strongly of the method used and substrate pretreatment, which will be demonstrated on the various templates: including a single-layer buffer of STO prepared by molecular beam epitaxy (MBE) and pulsed laser deposition, a multilayer buffer of Y-stabilized zirconia/CeO_2/$LaNiO_3$/STO, and STO-coated two-dimensional nanosheets of $Ca_2Nb_3O_{10}$ (CNO) and reduced graphene oxide. A case study, based on SrO-assisted deoxidation and controllable coverage of silicon surface with a layer(s) of spin-coated graphene oxide, will illustrate ability to grow a high-quality STO pseudo-substrate suitable for further PLD overgrowth of functional oxides, such as $PbZr_{1-x}Ti_xO_3$ (PZT), enabling advanced energy conversion system based on microelectromechanical and electrochemical principles.

INV1

The effect of zeolite type and concentration on thermal and mechanical properties of zeolite-poly(methacrylic acid) composite hydrogels

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The effects of two zeolite types (LTA and MFI) and concentration on thermal stability and degradation mechanism, as well as mechanical properties of poly(methacrylic acid) based composite hydrogels was investigated.

Zeolites were embedded in polymeric matrix in concentrations from 26 to 52 mass%. SEM revealed that despite high zeolite concentration, the composites kept porous hydrogel structure with uniformly dispersed zeolite particles for both zeolite types for all applied concentrations.
Both zeolites were shown to be active fillers and notably improved all investigated properties. Thermal stability was increased with increasing zeolite concentration, but degradation mechanism of PMAA was differently affected. The introduction of the LTA zeolite stabilized certain products of PMAA degradation, preventing its degradation around 300 °C or delaying it for higher temperatures, while MFI zeolite disabled reactions leading to the formation of aromatic rings and char because of the interaction of polymers chains with the external surface of the zeolite. The increase in zeolite concentration caused the redistribution of the ratio of certain TD stages. Zeolite inclusion improved mechanics in dry and swollen state, up to 2- and 4.9-times higher storage modulus for MFI-PMAA, respectively, and much more pronounced increase for LTA-PMAA composite hydrogels, 5.2 and 21.8 times, respectively.

INV2

The power of machine learning

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The application of artificial intelligence (AI) is everywhere. The aim of this paper is to show some of the applications of machine learning (ML) in all sciences. We will pay special attention to the application of ML in materials. Models that are currently being applied and to which problems they are being applied with reference to some new model proposals that have not yet been tested. Optimization algorithms often require an iterative evaluation of the objective function. Therefore, computationally efficient modelling approaches are essential in implementing and speeding up the subsequent optimization algorithms. In recent years, the application of Deep Neural Networks (DNN) has become widespread in various fields due to their ability to capture nonlinear dynamics in complex models

INV3

Poly(dimethylsiloxane)-based polyurethanes and nanocomposites for biomedical and electronic applications

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Polyurethanes (PUs) (such as thermoplastic PU and PU networks) and PU composites are important materials and are extensively studied and used as polymer systems. PUs based on poly(dimethylsiloxane) macrodiols (PDMS) are used as biocompatible materials with suitable

flexibility at low temperature. The popularity of PDMS-based PU nanocomposites is due mainly to the simplicity of tuning their functional properties. PDMS-based thermoplastic PUs, currently utilized for biomedical applications, have sub-optimal biocompatibility in terms of resistance to cell adhesion and relatively poor support for endothelial cell growth. In order to significantly improve and extend clinical applications of PDMS-based PU materials, the aim of the research was to enhance the endothelial cell attachment and blood-contacting properties of these materials. This study is focused on the synthesis, structure, surface, thermal and mechanical properties and biocompatibility of PDMS-based PU materials. The correlations between chemical composition or nanofiller addition and physicochemical properties of PU materials were studied, applying complementary experimental techniques. The addition of some nanofillers into PU network and TPU with higher hard segment content led to improved thermal, mechanical and surface properties, and the materials exhibited low adsorption of proteins and good cell attachment, which is promising for potential biomedical applications. Additionally, a flexible strain sensor, consisting of flexible polyurethane and a conductive MXene layer, has been successfully assembled and characterized. This development paves the way for the creation of novel PU/MXene nanocomposites, which could be customized for developing suitable coatings for sensing applications.

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INV4

Novel multifunctional electrochemically active microalloyed composite and nanomaterials, with accompanying scientific discoveries of processes, morphologies and solid-state active contact phenomena

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Electrochemically active aluminum invention (M. Purenović, doctoral dissertation 1978) led to the discovery of numerous structural properties of negative stationary electrode potential, electrical conductivity, oxidation process kinetics by 10^6 times and nanostructured fragmented crystals creation. Crystal structure amorphization of metal and oxide layer with fractals of crystalline nanostructure, led to creation of matrix for fractals and crystal grains contacts with amorphous layer, which are responsible for numerous charge exchange processes. Comprehensive invention of numerous metals microalloying is designed as a multiphase system: metal (Me) – MeO – oxidant, with physically complex contacts for exchange of mass and charge carriers of electrons and electron-holes, where the foundations for **quantum electronics** are placed, as a new area for contact barriers located in dielectric volume (oxide and ceramic). This accompanying scientific discovery indicates the importance and role of crystals of any dimensions, as the contact between amorphous layer and crystal is responsible for numerous electron and electron-hole exchange processes in the solid phase of active dielectric according to the principles of **quantum electronics**, and not according to Brillouin zones, which are valid for pure metals and semiconductors.

Composite ceramics is based on multiphase active microalloyed and alloyed aluminosilicate ceramics with an ordered matrix, which ensures a favorable relationship between crystallinity and amorphousness. By choosing synthesis parameters, microalloying with Al and alloying with Mg, the ratio of crystallinity and amorphousness is changed, all structurally sensitive properties are encouraged and the fractal nature is pointed out (J. Purenović, doctoral dissertation 2013). Fractal nature of grain contour, macro, meso and micro pores and nanostructured phases layered along grain boundaries make this material an **active dielectric**. Synergistic effect of additives, dislocations and present admixtures leads to dislocations movement along grain boundaries and **fragmentation of existing grains** into a large number of micrograins with a distinct fractal nature. Primary microstructure and crystal grains and intergranular space amorphization resulted in surface activity by creating new energetic surface states and opportunities for cluster conduction and electrons and ions exchange through solid phase of multiphase dielectric (quantum electronics). Starting point is that this composite ceramics structure exhibits electrochemical activity in contact with water, exhibiting reducing properties to harmful ions present in the water.
It is worth highlighting one scientific discovery related to phenomenon of fragmentation; whether it is carried out spontaneously or forcibly, further fragmentation stops when formation of **mosaic blocks** occurs in the matrix, which have genetically predetermined structure of **dominant lattice matrix**. Therefore, scientific results that have useful value will be presented. In particular, nano particles in nano hydrodynamics with several scientific discoveries will be highlighted.

INV5

V_2O_5-based nanostructured powders as a cathode material for post-lithium aqueous batteries

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Rechargeable Li-ion batteries with organic electrolytes have a wide range of applications owing to a high energy density and power density, voltage stability and wide operating temperature range. A high price of Li-ion batteries due to scarcity of lithium has led to the development of post-lithium batteries such as Na-, Mg-, Zn-, and Al-ion batteries based on abundant and low-cost resources. Moreover, organic electrolytes pose a potential risks such as flammability, also may contain hazardous chemicals and require specialized assembly techniques. The advantages of aqueous electrolytes compared to organic ones are environmental friendliness, safety, cost-effectiveness, and quicker and easier manufacturing processes. In post-lithium aqueous batteries, vanadium-oxide can play a crucial role as a cathode material due to its favorable electrochemical characteristics and availability.
During the years, using different synthesis procedures and characterization techniques, we developed variety of V_2O_5-based materials suitable for utilization in Li-, Na-, and Mg-aqueous batteries. Here, a comprehensive overview about V_2O_5-based nanostructured powders developed by our group and used as a cathode material for post-lithium aqueous batteries will be provided.

INV6

Magnetically soft and semi-hard materials

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This study focuses on two ferromagnetic materials as representative of soft (MnZn ferrites) ceramics and semi-hard (FeCo-2wt%V) alloys, both with unique properties in a wide specter of magnetic materials.

Recently, a variety of technologies have been examined for MnZn ferrite production: Powder/Ceramic Injection Moulding (PIM/CIM), chemical co-precipitation method, conventional ceramic processing, sol-gel or microemulsion. MnZn ferrites are one of the most common electronic ceramics for application as a material for microwave components (radiofrequency transformers, antennas, transducers, inductors, magnetic fluids, sensors…). They attracted attention due to the wide range of relative magnetic permeability values (from 10^3 to 10^4), high electrical resistivity (consequently low magnetic losses) as well as high thermal stability (high saturation magnetic flux density at high temperatures ($B_s > 0.4$ T @ 100 ^{O}C) and a relatively high Curie temperature (about 230 ^{O}C). Toroidal samples with dimensions appropriate for applications in microelectronics (inner diameter 3.5 mm, outer diameter 7 mm, height 2 mm) exhibit very stable maximum magnetic permeability in the frequency range from 50 Hz ($\mu_r \approx 480$) to 10 kHz ($\mu_r \approx 450$) @ 200 A/m. Active power referred to unit mass of about 30 W/kg was recorded at a frequency of 1 kHz (@ 280 mT. Those results were competitive with the catalog data for MnZn components devoted to applications in electronics.

Magnetically semi-hard near equiatomic FeCo-2V iron-cobalt based alloy is known for its exceptional combination of high values of saturation magnetic flux density B_S and Curie temperature T_C (about 950 ^{O}C - it is a unique alloy with this property). Binary alloys of Fe − Co systems containing 33-55 wt.% Co are very brittle, but the addition of about 2 wt.% V prevents transformation into an ordered superlattice structure and enables a relatively high value of electrical resistivity (V as alloying element provides very good mechanical and suitable electrical properties compared to other alloying elements, W, Ti, Mo, Mn, Ta, Cu). The XRD patterns of FeCo-2wt%V (FeCoV) alloy produced by Metal Injection Moulding (MIM) technology exhibit the main diffraction peak of the α'-FeCo phase (crystal structure type B2) which increases with an increase in sintering temperature up to 1460 ^{O}C. The mechanical hardness does not coincide with the magnetic hardness, i.e. the material with the highest HV10 (value of 348) shows the lowest coercive force H_{cJ} (about 18.4 Oe). Magnetic hardness is associated with the magnetic obstacles that prevent easy movement of magnetic domain walls (“pinning” effect). However, for mechanical hardness, the movement of dislocations, i.e. the prevention of this movement, is crucial (the elements in microstructure are highly efficient in blocking the movement of dislocations, but not that of the Bloch magnetic domain walls). As the hysteresis losses are proportional to the frequency (~ f) and eddy-current losses are proportional to the square of

frequency (~ f^2) it was performed separation between these two components from total magnetic power (active) losses. Numerical fitting of this functionality on frequency was performed and analyzed, as intermetallic FeCoV components can be used competitively in strategic applications, for example, the aerospace motor rotor.

INV7
Measurement of dielectric and magnetic properties of ceramic materials

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For radio-frequency applications in electrical engineering, the relative permittivity and the relative permeability are the most important parameters of ceramic materials. They characterize a material with respect to its dielectric and magnetic properties, respectively. We have developed a set of methods for measurement of these parameters in a wide frequency band, from the audio frequencies, up to deeply in the microwave region. The methods are based on our original test fixtures tailored for samples of ceramic materials, measurement of network parameters using vector network analyzers and impedance meters, and de-embedding of the permittivity and permeability using our original, fast, and accurate numerical techniques for modeling of electromagnetic systems. We use rotationally symmetrical test fixtures for measurement of the permittivity, along with proprietary high-precision methods for the quasi-static analysis and for the full-wave analysis of such electromagnetic structures. For measurement of the permeability, we use strip transmission lines with a method for the full-wave analysis of arbitrary electromagnetic systems developed at our school. The methods provide frequency-swept data and take into account conductive, dielectric, and magnetic losses of materials. Our test fixtures can be used at temperatures up to 180 °C and one fixture is convenient for measurement in sintering furnaces.

INV8
Hydroxyapatite and hydroxyapatite-cellulose composite materials as functional ingredients in cosmetic products

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Calcium-phosphate materials (CaP) consist of stable ions in physiological conditions, with biocompatible characteristics showing exceptional resistance to microbiological influences, changes in the pH of the environment, and having a deficient solubility product in physiological conditions. Hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$- HAp is one of the most used materials from the CaP group since it has a high specific surface area and antimicrobial activity and can be used as potential antimicrobial material. Bacterial cellulose (BC) is a biopolymer that stands out in its biodegradability, biocompatibility, and high water retention capacity, but also lacks functional properties. The main goal of this study was to develop green technologies and to create a newly designed composite material with the functionalization of cellulose by hydroxyapatite with antimicrobial properties. The second goal was to connect science and entrepreneurship to obtain improved cosmetic products using the obtained materials. Hydroxyapatite material was incorporated in wet cellulose during the precipitation synthesis reaction. Obtained Hap and BC-HAp materials were structurally and phase investigated by the XRD method. The morphology of the obtained material was done by SEM, and appropriate functional groups were determined by the FTIR method. The obtained materials were used for final functional cosmetic product development.

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INV9
Development of oxidation protective coatings on ZrB_2 based UHTC materials using magnetron sputtering method

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The oxidation of ZrB_2 based Ultra-High Temperature Ceramics (UHTCs) leads to the formation of liquid B_2O_3 and porous ZrO_2. Increased evaporation of B_2O_3 above 1500°C restricts the usage of ZrB_2 for long term applications. Overlay coatings for oxidation protection has been explored for the first-time using magnetron sputtering. Coatings such as HfO_2, Gd_2O_3 and metallic Nb are applied on top of ZrB_2 and high temperature oxidation tests up to 1700°C are conducted for various times. The application of protective coatings has proven the increased oxidation resistance of ZrB_2 at the studied temperatures and times. The underpinning oxidation mechanisms are understood and identified as 1) Formation of a liquid solution with B_2O_3 and decreasing its evaporation rate and 2) Densification of ZrO_2 scale by means of liquid phase sintering or solid solution formation.

INV10
Effects of rare earth ions doping on microstructure and electrical properties of barium titanate ceramics

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$BaTiO_3$ ceramics doped with donor and acceptor additives were prepared by conventional solid-state sintering. The rare earth ions (La, Sm, and Dy) were used as donor dopants, in a concentration of 0.1 to 2.0 at%, while the concentration of Mn as an acceptor was 0.05 at% in all samples. The ground and pressed specimens were sintered at 1320°C and 1350°C in an air atmosphere for two hours.

SEM investigations of the samples doped with a low concentration of additives showed that these samples are characterized by a mainly uniform and homogeneous microstructure with an average grain size ranging from 0.5 μm to 5.0 μm. In highly doped La/$BaTiO_3$ and Dy/$BaTiO_3$ samples, sintered at 1350°C, was observed the appearance of secondary abnormal grains in the fine-grained matrix and core-shell structure. For the samples sintered with Sm, a fine-grained structure was characteristic for all concentrations.

The samples sintered at 1350°C and doped with a low concentration of additives have a high value of dielectric permittivity at room temperature, 3200 for La/$BaTiO_3$, 6850 for Sm/$BaTiO_3$, and 5950 for Dy/$BaTiO_3$. An almost flat permittivity-temperature response is characteristic of samples with an additive content of 2.0 at%. The critical exponent γ and the Curie constant C' were calculated using the modified Curie-Weiss low. The obtained values of critical exponent indicate the diffuse phase transformation in heavily doped $BaTiO_3$ samples.

INV11
Synthesis and Properties of (Hf,Mo,Ti,W,Zr)B_2–(Hf,Mo,Ti,W,Z)C Dual Phase Ceramics

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Composites based on high entropy borides / high entropy carbides are good candidates for applications in extreme environments based on ultra high melting temperatures above 3000 °C. Dense, dual phase (Hf,Mo,Ti,W,Z)B_2–(Hf,Mo,Ti,W,Zr)C ceramics were synthesized with varying contents of Mo and W. The final $(Hf_{0.317}Mo_{0.025}Ti_{0.317}W_{0.025}Zr_{0.317})C$–

$(Hf_{0.317}Mo_{0.025}Ti_{0.317}W_{0.025}Zr_{0.317})B_2$ was a nominally pure, dual phase ceramic, while compositions with higher amounts of Mo and W contained multiple phases. Optimized ceramic had submicron grains due to pinning effects between the two phases. Super-hard ceramic was obtained with Vickers hardness values up to 48.6 ± 2.2 GPa for an applied load of 0.49 N. The solubility limits for Mo and W into the (Hf,Mo,Ti,W,Z)B_2–(Hf,Mo,Ti,W,Zr)C ceramics were mitigated by decreasing their contents to 2.5 at. % each. A nominally pure dual phase ceramic densified by spark plasma sintering or hot pressing was obtained. A synergistic hardening effect was observed for optimized ceramic, whereby it had a higher hardness than individual HEC and HEB phases containing the same transition metals.

INV12
The Evolution of Chemical Analysis in the Construction Industry: Adapting Methodology to New Eco-Friendly Materials

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Intensive industrialization and urbanization have led to an increasing demand for solutions that contribute to faster and, at the same time, higher-quality chemical analyses in the construction industry. In the field of supplementary cementitious materials, intensive research is being conducted into the potential application of various natural and artificial materials that exhibit binding properties under specific conditions. The use of such materials, which can partially replace Portland cement, is far from reaching its full potential and represents an alternative that could sustainably produce Portland cement in the future. This, in turn, impacts the depletion of raw materials used in cement production, reduces the amount of deposited secondary raw materials, and ultimately reduces CO_2 emissions into the atmosphere.

In this regard, new challenges arise for adapting instrumental chemical methods for analyzing the compositions of multicomponent materials. The development of new ecological materials implies the development of innovative, fast, and economical chemical testing methods. For this purpose, these newly established methods need to be validated. The validation of an analytical method involves analytical procedures essential for obtaining reliable and reproducible results for routine analysis. The validation process encompasses characteristic numerical validation criteria (parameters) for evaluating the analytical method. The following parameters are used for validation assessment: selectivity, accuracy, precision, detection limit, quantification limit, sensitivity, working range, linearity, truthfulness, and robustness.

Two analytical techniques used are energy-dispersive X-ray fluorescence spectrometry (EDXRF) and inductively coupled plasma optical emission spectrometry (ICP-OES), as well as preparation methods related to them. To enhance these techniques, mathematical tools are applied through multivariate statistics. The application of multivariate statistics leads to the development of various models, some of which predict sample grinding times, while others establish connections between results obtained from different techniques or detect outliers, all contributing to the modernization of database organization.

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INV13

Silver Linings: Nanowires in Optoelectronics

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For their ease and cost-effectiveness of wet synthesis and processing i.e. from liquid phase, silver nanowires have been extensively studied as a transparent electrode alternative to conventional solutions like indium tin oxide.
Elucidating the solid-state wetting and welding mechanisms that occur during annealing of Ag nanowires before a layer of Al doped ZnO is deposited, can lead to the enhancement of essential electrode properties. Microstructural characterization using (S)TEM revealed that solid-state wetting and subsequent welding occurred only between nanowires whose contact geometry is characterized by an enormous difference in radii of curvature.
A fully solution-processed AgNW/ZnO film was studied to understand how ZnO coating affects the electrical stability of nanowires, including the degradation mechanism under high electrical current densities. The nanocomposite transparent electrode was processed with different numbers of ZnO coatings to evaluate their impact on optoelectronic properties and electrical stability. The results showed that nanowires with a triple ZnO coating had the optimal combination of optoelectronic properties and stability at the highest working voltage.
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INV14

Comparative structural analysis of M-doped (M = Ru, Sb, Ni, Co) TiO_2 as support materials in Pt-based catalysts for application in fuel cells

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This study presents the initial findings from a continuous comparative analysis of transition metal oxide-based nanocrystaline support materials that could be used in direct ethanol fuel cells. Additionally, a straightforward method for creating interactive catalyst supports was introduced in order to facilitate the easy scale-up of catalyst production. The structural and morphological characteristics of the synthesized interactive support materials based on M-doped TiO_2 nanocrystals (M = Ru, Sb, Ni or Co), along with Pt-based catalyst, were studied by XRD and SEM. The electrocatalytic efficiency of developed Pt-based catalyst on the M-doped TiO_2 nanocrystalline support tested in the ethanol oxidation reaction (EOR), in alkaline and acidic

conditions, indicated promising performances for some of the M-doped TiO_2 nanocrystalline support compared to the commercially available catalysts.

INV15

Linear Parameter Varying sensorless Torque Control for Singularly Perturbed photovoltaic pumping system with Torque and Flux observers

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In this work, a new approach being different from the concept of DTC and IFOC for a robust torque control design for induction motor feed by a photovoltaic system is addressed. The design is based on the framework of singularly perturbed system theory and linear varying parameter systems. In these systems, the rotor flux is considered to be a time-varying parameter in orderto guarantee a robust torque control with LPV flux observer with respect to the speed and resistance variations. In fact, this observer is designed to estimate the rotor flux as well as an MRAS observer is introduced to estimate the mechanical speed and rotor resistance. The main feature of this proposed structure is the enhancement of robustness with flux, speed and rotor resistance variation. This improvement leads to a considerable decrease of the torque ripples and ensures the stability for the entire operating range. The obtained simulations and experimental results are used to validate the effectiveness of the proposed control strategy.

INV16

Utilizing NiFeMo based ionic activators in alkaline electrolysis: A combination of experimental and theoretical methods

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Improvement of energy efficiency of alkaline water electrolysis represents a topic of wide interest from fundamental and application aspects. Use of in situ activators is a simple, cost-efficient method that enables better efficiency of hydrogen production on common metal cathodes, comprising addition of metal salts into the electrolyzed solution. Despite remarkable effects on the electrolysis performance, with only a few studies published in the last decade, the systematic knowledge on the behavior and properties of ternary ionic activators is still lacking. This contribution deals with a novel, Ni-Fe-Mo ternary system for the ionic activation of Ni electrode. In addition to experimental investigations, the application of DFT calculations to represent the

activated electrode surface and its interaction with HER intermediates, is expected to help understanding the electrode process from the fundamentals to the application level.

INV17

Spectroscopic Analysis of Beryllium Ceramics

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Beryllium and beryllium ceramics are highly valued for their exceptional properties crucial in aerospace, telecommunications, and nuclear reactors. They boast superior thermal conductivity, electrical insulation, and mechanical strength, essential for electronic substrates, heat sinks, and as neutron reflectors in reactors such as ITER. Their resilience in challenging environments, including fusion reactors, underscores their versatility. This study utilizes beryllium ceramics to compare two experimental designs for spectroscopic observation of beryllium lines. The first design involves the erosion of beryllium ceramics, leading to the production of beryllium dust critical for plasma diagnostics and erosion monitoring. This novel plasma source was developed to safely record beryllium lines, optimizing conditions for spectral line appearance and measuring electron density and temperature. In the second design, efforts are focused on preventing dust production to ensure a dust-free environment for precise measurements. This comparison highlights the differences in experimental design and their implications for studying beryllium spectral lines. It investigates the impact of dust on line parameters, offering insights into the utilization of beryllium ceramics in advanced scientific and industrial applications.

INV18

HEMP COMPOSITES: A Sustainable Alternative for Advanced Material Applications

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Hemp composites have emerged as a promising material in the field of sustainable engineering due to their unique combination of mechanical properties, environmental benefits, and cost-effectiveness. This study explores the potential of hemp-based composites as an alternative to conventional synthetic materials, focusing on their mechanical properties, biodegradability, and potential applications in various industries.
The research investigates the preparation, characterization, and performance evaluation of hemp fiber-reinforced composites. The results highlight the significant impact of fiber treatment processes and composite manufacturing techniques on the overall properties of the final material. By comparing hemp composites with traditional materials such as glass and carbon fibers, the study emphasizes the advantages of hemp in terms of weight reduction, energy efficiency, and lower environmental footprint.

Furthermore, this paper discusses the challenges associated with the widespread adoption of hemp composites, including issues related to standardization, production scalability, and long-term durability. The potential applications of hemp composites in automotive and construction are explored, showcasing their versatility and economic viability.
This research contributes to the growing body of knowledge on sustainable materials and supports the integration of hemp composites into mainstream industrial applications. The findings underscore the importance of continued innovation in the development of natural fiber composites to address global sustainability challenges.

INV19

About the Dehydration of Lanthanum Hydroxide – Reaction Mechanism and its Kinetic Studies

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The dehydration mechanism of lanthanum hydroxide ($La(OH)_3$) was investigated employing thermogravimetric measurements (TG) and temperature-dependent X-ray powder diffraction (HT-XRD) [1,2]. The results obtained by Thermal Analysis and in particular Thermogravimetry can be influenced by sample preparation. Depending on the particle size Thermal Analysis results describe both, the chemical reaction and further processes such as transportation or diffusion of the evolved gases. The dehydration of lanthanum hydroxide can be formally described as follows:

$$La(OH)_3 \Rightarrow LaOOH + H_2O \quad (1)$$
$$2\ LaOOH \Rightarrow La_2O_3 + H_2O \quad (2)$$

Determination of the crystal structure was carried out by means of X-rax diffraction and subsequent Rietveld refinement. Although, the chemical equations of the dehydration reactions are simple, the reactions are usually multistep mechanisms and can therefore not be sufficiently described with a simple Arrhenius approach. Measurements results of dynamic TG-data provided a basis for the thermokinetic aproach, which was made employing special software named Thermokinetics [3]. Using a multivariate non-linear regression the kinetic triplett consisting of pre-exponential factor, activation energy and reaction order can be refined independently for multistep reactions. For the above described reactions the obtained kinetic data give an indication of the reaction mechanism. The results correlate with pressure-dependent data obtained by differential scanning calorimetry (DSC) [4].

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INV20
Niobium MXenes: promising materials for applications in energy conversion and storage

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From its unique properties that combine the ceramic properties of high thermal stability with metallic conductivity, high surface area, hydrophilicity, low density and charge retention capacity the newest class of two-dimensional materials, MXenes, has expanded and achieved numerous applications mainly in electrochemical energy conversion and storage [1, 2, 3]. Materials that can be synthesized by selective chemical etching of three-dimensional carbides and nitrides: ceramic MAX phases [4]. The properties of MXenes can vary depending on the transition metal and the number of its layers. Niobium carbide MXenes, for example, have excellent conductivity with approximately zero band gap, spacing between layers that favors the transport and intercalation of ions and high environmental stability [5, 6]. These characteristics make niobium MXenes promising as electrocatalyst materials for electrochemical energy conversion devices and charge storage materials in supercapacitor devices. Therefore, this work presents niobium MXenes synthesized from the chemical etching of its MAX phase by the MILD method (1g of MAX phase +1g of LiF +8.5 mL of HCl) and characterized regarding its morphology and structure and electrochemical activity for conversion devices and energy storage.

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INV21
Physicochemical and biomimetic information for evaluating compound quality

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During the early stages of drug discovery, it becomes increasingly important to obtain a basic profile of a candidate molecules using efficient and cost-effective biomimetic systems. These systems simulate the behavior of molecules in the bioenvironment and illustrate their quality and physiological impact. The most common are chromatographic systems combined with retention modeling for data processing and include lipophilicity measurements and estimation of plasma protein binding. We used mixed-mode hydrophilic (HILIC) and reversed-phase (RP) stationary phase to provide a reliable molecular interpretation of the retention behavior of serotonin and imidazoline receptor ligands. We also conducted a comparative study on the biomimetic potential of the dual HILIC/RP interaction mechanism. The resulting nonlinear retention is described using the Box-Cox transformation methodology. The integration method introduced novel retention parameters of the HILIC/RP mechanism, which showed a successful correlation with the physicochemical properties of the tested compounds. Using predictive machine learning modeling, we investigated the physicochemical consequences of nonlinearity in the HILIC/RP regime. The reliable application of novel retention parameters in pharmacokinetic profiling was confirmed. The obtained results can accurately assess the key properties of newly synthesized ligands while reducing costs and selecting appropriate candidate compounds in the early stages of drug discovery.

INV22
Use of perlite as nickel catalyst support in sunflower oil hydrogenation process

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The objective of this study is utilization of broken honeycomb-like expanded perlite as a support for active nickel-based catalysts promoted with magnesium, for hydrogenation process of sunflower oil. The investigation focuses on assessing the impact of varying nickel and magnesium concentrations on the morphology (SEM), structure (FTIR and DR-UV/Vis), texture (N_2-physisorption and Hg-porosimetry), and reducibility (TPR and H_2 chemisorption) of catalyst precursors, as well as their influence on the catalyst's activity.

Employing the precipitation-deposition method and H_2 dry reduction procedure, an active nickel-based catalyst modified with magnesium for sunflower oil hydrogenation can be synthesized. After precursor synthesis, changes in morphology, texture, and structure due to overall nickel and magnesium content, as well as the reducibility of supported precursors and dispersion of Ni^0 in reduced precursors, was established. Morphological analyses confirmed the successful deposition of nickel-magnesium species on the broken honeycomb-like structure, with nickel basic carbonate species predominantly present and species interacting with the support, as confirmed by FTIR, DR UV-Vis analysis, and TPR measurements. It was determined that the catalyst's activity is strongly influenced by the reduction temperature of precursors (most active catalyst T_{red} = 345 °C), with optimal mole ratios of nickel to silica at 0.25 and magnesium to nickel at 0.1.

ORL1

Development of a numerical procedure for assessing the fracture resistance of materials for pressure pipelines using the ring specimens

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The main topic of this work is evaluation and enhancement of procedure for fracture mechanics parameters determination in thin-walled pipelines under extreme load conditions, focusing on the impact of non-standard specimen geometries and additive manufacturing techniques. In addition to mechanical testing, we utilized finite element analysis (FEA) with the Simulia Abaqus software to further understand the influence of geometrical ratios and variations in specimen design, such as the cylindrical shape and the presence/size of one or two sharp stress concentrators. The main results extracted from numerical calculations are quantities needed for determination of the *J*-integral: stress intensity factor K_I, plastic geometry factor η and crack propagation correction factor γ. A generally linear relationship is obtained between the calculated parameters and the geometric ratio (a/W), suggesting that the variations in specimen width, wall thickness, and cross-section have a quantifiable impact on the material`s fracture behavior. This integrated methodology not only provides a comprehensive understanding of the fracture mechanics of thin-walled pipelines but also demonstrates the procedure's potential for practical implementation in structural assessment and material development for industrial applications.
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ORL2

AI aided biomaterials research: stabilization of selenium nanoparticles with proteins

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In the last few years, we witnessed the revolutionary development of LLMs based on various transformer architectures opening up numerous research and application possibilities of AI models everywhere. The specific architecture, the vast amount of data trained on, and broad knowledge generated within these models give them the ability to understand concepts, plan and solve different kinds of problems, including various chemistry-related tasks. In our previous work, we explored the performances of the GPT4 model on common tasks related to language models, such as text classification, information extraction and, finally, the prediction of proteins suitable for stabilization of Se nanoparticles (SeNp).
Herein we continue to explore advanced prompt-engineering techniques and extrapolate those techniques to GPT-like models available (LLamma, Mistral and Claude). We benchmarked those models and compared their performances with those already tested in GPT4. We have used UniProt resources, original research, and review articles as data source and to evaluate performances of models. For data operations, interaction with models we used Python programming language and Jupyter Notebooks for demos.
The study demonstrated abilities and limitation of latest open-source LLMs in field of protein data understanding and knowledge generation in domain of SeNp stabilization and functionalization.

ORL3

The influence of mechanical activation parameters as a function of producing a Magnesium aluminate ($MgAl_2O_4$) spinel

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Magnesium aluminate spinel (MAS) has excellent mechanical, chemical, thermal (high melting point, higer than 2100 °C) and optical properties. Also it has a low dielectric constant (ε_r~8). Based on those properties, $MgAl_2O_4$ has found a significant application in refractory ceramics, radomes, transparent armor, optically transparent windows, integrated electronic devices, etc. In this research, MgO was calcined at 1000°C for an hour, in order to avoid presence of hydroxide or carbonate. MgO and Al_2O_3 powders were mixed in a one-to-one molar ratio and mechanically activated for 15, 30, and 60 minute and pressed in the tablets, under the pressure of 0.5 t. The

pressed powders were heated up to 1300 ^{o}C and held for 1 h for the reaction. After that, obtained spinel powders were sintered at 1450 ^{o}C for 2 h. Both sintered and non-sintered samples were investigated by XRD, SEM, PSA and Raman spectra. All results are in accordance with our previous results, and the pure dense spinel phase is obtained. XRD shows that mechanically non-activated specimen as well as activated sintered specimens show the pure $MgAl_2O_4$ phase after sintering at 1450°C. Raman spectra revealed that mechanical activation leads to an increase in the degree of the exchange between Mg and Al cations, due to the introduction of defects during the milling process. The study shows that a precise setting of mechanical activation parameters enhances sinterability, phase formation and microstructure homogeneity of reaction sintered MAS ceramics.

ORL4

Anisotropic Cracking and Lack Thereof in MAX Phases

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In this work, we demonstrate that in atomically layered ceramics, such as MAX phases, crack growth is extremely anisotropic and for certain crystal orientations, no crack growth occurs even under Mode I loading. We will present the results of micromechanical testing of notched cantilever beams of chromium aluminum carbide MAX phase. The experiments are carried out for specimens with the basal (slip/cleavage) planes oriented either parallel, perpendicular or at an angle close to 45 degrees relative to the notch. The results show that when the basal planes are parallel to the notch, specimens undergo unstable cracking. However, when the basal planes are at 45 degrees with respect to the notch, no cracking occurs, and the notched samples undergo extensive crystallographic slip. In addition to the experiments, we will also present crystal plasticity finite element simulation results rationalizing experimental observations.

ORL5

Densification and Properties of High Entropy Boride-SiC-B_4C Ceramics

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Borides mixed with equal volume fractions of SiC and B_4C have improved properties such as higher hardness (~33 GPa at 1 kgf) and higher strength (~1 GPa) compared to the individual phases. High entropy borides have also been shown to have improved properties such as higher hardness compared to single-metal borides. The present work used (Cr, Hf, Ta, Ti, Zr)B_2 as the

boride phase in the boride-SiC-B_4C ceramics in order to improve the hardness. The high entropy boride was synthesized using high energy ball milling combined with boro/carbothermal reduction. The powders were mixed by wet ball milling and densified at various temperatures using spark plasma sintering. Scanning electron microscopy was used to image the resulting microstructures. Hardness was measured over a load range of 0.05 to 1 kgf using both Vickers and Knoop indentation. Strength was measured using four-point flexure. The discussion will focus on microstructure development and hardness.

ORL6
Crystal Structure Monitoring - New Insights into the Familiar Ion-Conductive Ceramics

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Ion-conductive ceramics are widely studied as cathode active materials and solid electrolytes within various battery concepts. Indeed, crystal structure defines the main functional properties of such materials. However, most studies limit structural analysis to the initial verification of the material's identity — keeping any further discussion in a perspective of phase purity. In this presentation, we will provide examples of how deep structural investigation can highlight the early stages of material transformation and give valuable insight into conductive features and stability. We will follow the changes that can be observed in two well-known ceramic materials: Li-conductive solid electrolyte $Li_{1.3}Al_{0.3}Ti_{1.7}(PO_4)_3$ (Nasicon structure type) and Na-conductive cathode active material $Na_{0.67}Mn_{0.5}Fe_{0.5}O_2$ (P2 structure type). It will show how fine structural investigation can elucidate multiple aspects: from the charge carrier migration paths to the applicable recommendations for synthesis and storage conditions that can improve the materials' performance. The main analytical tool used in this overview is powder X-ray diffraction combined with the Rietveld refinement — applied along with accompanying electrochemical, chemical, and morphological studies.

P1 Poster Session I
Change in Magnetization and Resistivity of the Fe/Pb/Zr/$BaTiO_3$ System Driven by Time of Mechanochemical Activation and Thermal Treatment

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Powdery mixtures of 50 mass % Fe, 4 mass % Pb, 3 mass % Zr and 43 mass % $BaTiO_3$ were activated in a planetary ball mill for time periods starting from 30 min up to 300 min, with an increment of 30 min. Samples were subsequently pressed and sintered for 2 hours at 1200 °C in the air atmosphere. It was observed that the pressing alone, i.e. without sintering, led to a decrease of magnetization in all of the samples. The process of sintering further decreased the

magnetization of all the samples, with the most prominent drop of 90.11 % belonging to the sample activated for 150 min. Samples activated for 90 min, 180 min and 300 min were subjected to subsequent cycles of heating to Curie temperature of 345.26 °C, then cooling to 25 °C, in the applied magnetic field of 20 kA m^{-1}, where an increase of magnetization in all of the samples was observed, with the biggest increase in magnetization of 198.56 % observed for the sample activated for 300 min. Heating of the sintered samples activated for 150 min and 270 min caused an asymptotic decrease of resistivity from the initial values of 50.0 Ω m and 57.3 Ω m at 20 °C, to 0.6 Ω m and 0.7 Ω m at 200 °C, respectively.

P2

Meteorite: SEM and structural characterization

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The use of meteorites in the ceramic industry is interesting, because the present metals can strongly attract magnets. A meteorite is a natural stone or solid object that has passed through the atmosphere from a region of the solar system.The paper presents the results of the examination of the presumed meteorite found in the Valjevo district. On the basis of X-ray powder diffraction analysis, the mineralogical composition was determined, with the most abundant mineral being olivine and the iron oxides-Wüstite. SEM analysis of the examined sample is also presented in the paper.

P3

Structural and microstructural properties of $(Sr/Ba)_2Al_2Si_2O_8$ ceramics phase

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The hexacelsian ($BaAl_2Si_2O_8$) is an important thermo-stable ceramic material because it has low thermal expansion and good dielectric properties. In this paper are presented the structural and microstructure data for diphylloaluminosilicates phases of Sr/Ba-hexacelsian, synthesized from Sr/Ba ion-exchanged zeolites of LTA and FAU topology. During prolonged heating this phase is polymorphic transformed to Sr/Ba-celsian feldspar. Synthesis of Sr/Ba hexacelsian and celsian was observed by X-ray powder diffraction method. The crystal structure and microstructural parameters were refined using Rietveld method. The crystal morphology of thermal treated samples was observed by SEM/EDAX analysis.

P4

Geopolymer Composites with Waste Materials Incorporation

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This study investigates and critically evaluates the possibility of using various waste materials (e.g., ceramic tile powder, eggshell, Fe-slag, and fly ash) as a supplementary resource in the production of geopolymer composites, examining their physiochemical properties and bonding mechanisms. Since the late 1970s, researchers have been looking into geopolymers as a potential new class of aluminosilicate binders that could someday take the place of conventional structural materials based on cement. Principles of the Green Agenda and Circular Economy, as well as the call for a reduction in CO_2 emissions, accelerated the search for a new sustainable bonding agent. Geopolymers are three-dimensional synthetic inorganic polymers that have amorphous or semi-amorphous crystal microstructures. In this paper, fly ash, which is known as a standard precursor for geopolymerization, was substituted with zeolite and bentonite in order to evaluate their proneness to alkali activation. Three composites have been prepared with different precursors: fly ash, zeolite, and bentonite. Particle size distributions of zeolite and bentonite were comparable to those of fly ash, which suggests that they can enhance densification, nucleation, and finally geopolymerization. Sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) solutions were used as alkaline activators. Biowaste (eggshell), construction and demolition waste (pulverized ceramic tiles), and industrial waste (Fe-slag) were added in the following quantities: 20%, 20%, and 10%. Thermally induced changes were analyzed by the DTA/DCS/TG method. Mineralogical phases were assessed via XRD. FTIR spectroscopy was employed in the assessment of the major reaction zones of Si-O and Al-O geopolymers. The microstructure was analyzed by means of scanning electron microscopy. Economically, the cost of employing raw materials is comparable to the cost of fly ash. Also, their environmental footprint is comparable, thereby making these composites a sustainable and cost-effective alternative. Notwithstanding, there is a necessity for further research on the mechanical performance and durability of these geopolymer composites.

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P5
Effect of the milling media on mechanical and thermal properties of ZrB_2

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The strength of ZrB_2 ceramics was tested by three different methods. Fully dense ceramics were produced obtained by hot pressing commercial ZrB_2 powder with the addition of 0.5 wt.% carbon as a densification aid. Three-point bending was performed in air at room temperature and the strength was 546 ± 55 MPa. Four-point bend strengths were measured under the same conditions resulting in strengths of 476 ± 41 MPa. The compressive was performed at room temperature and strength was 1110 ± 358 MPa. Finally, the fracture toughness of pure ZrB_2 ceramics was determined by the chevron notched beam method to be 3.6 ± 0.7 MPa•$m^{1/2}$. These values are higher than those previously published for ZrB_2 ceramics with comparable grain size, and can be attributed to higher density and lower porosity. The strength-limiting flaw sizes were comparable to the grain size, suggesting that porosity and segregation of impurities at the grain boundary did not play a significant role in strength of these ceramics.

P6
Utilization of *Aspergillus niger* for nanoparticles synthesis from old flotation tailings Majdanpek (Serbia): A study via field emission scanning electron microscopy

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Flotation tailings, a residual product of mineral processing, present significant environmental challenges due to their composition and disposal requirements. This study investigates an innovative approach that harnesses *Aspergillus niger* for synthesizing nanoparticles from old flotation tailings sourced from Majdanpek, Serbia. Leveraging the biological activities of microorganisms offers a sustainable strategy to convert waste into valuable nanomaterials.
Under controlled conditions, *Aspergillus niger* was cultured in the presence of flotation tailings. Electron microscopy has played a pivotal role in elucidating the nanoparticle synthesis process

and understanding the characteristics of the resulting nanomaterials. The imaging technique revealed successful nanoparticle synthesis by *Aspergillus niger* from the flotation tailings, demonstrating a variety of shapes and sizes that highlight the versatility of the biological synthesis process. Detailed structural analysis of both the flotation tailings and the synthesized nanoparticles provided valuable insights into their formation mechanisms and compositions. This approach not only demonstrates the feasibility of using old flotation tailings as a precursor material but also underscores the importance of sustainable resource management.
The nanoparticles obtained hold promise for diverse applications in biomedical, environmental, optical, and quantum technologies, showcasing their potential to contribute significantly to various fields.
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P7
Clay-supported cobalt oxide catalyst for glucose oxidation: impact of different types of clay and cobalt incorporation methods

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This research is part of a study on developing clay-supported cobalt oxide materials as potential electrocatalysts for glucose oxidation reaction (GOR-CoClay). In particular, the effect of the different types of clay and cobalt incorporation methods on the electrochemical performance of GOR-CoClay was investigated. Two clays from Wyoming and Bogovina deposits, in which cobalt was incorporated by incipient wetness impregnation method and pillaring, were examined. The catalysts were characterized by XRPD and ICP-OES. The electrochemical performances in terms of sensitivity and current response were evaluated using cyclic voltammetry and chronoamperometry. This study found that both methods of cobalt incorporation produced functional catalysts. However, using the pillaring method was not always successful and sometimes resulted in the formation of inactive catalysts. Conversely, the impregnation method made cobalt incorporation easier and more reproducible, suggesting its preference for synthesizing GOR-CoClay. Further, the results indicated that the different types of clays regarding Al/Si ratio and Fe content significantly impact the electrochemical performance of GOR-CoClay. The presence of a higher Fe content improved current response and sensitivity. The exact role of the Al/Si ratio on GOR-CoClay performance will be the subject of our further research.
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P8

Physico-chemical and antibacterial properties of TiN coated nitinol archwires

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Nitinol (NiTi) archwires are widely used in orthodontic treatment due to their unique properties: the shape memory effect and superelasticity. The biggest drawback of NiTi application in orthodontic treatment is chemically or microbiologically induced corrosion, resulting in release of toxic nickel ions. The aim of this study was to improve corrosion resistance of NiTi archwires by coating them with titanium nitride (TiN) and also to and introduce antibacterial properties by doping TiN with copper (Cu).
Combined methods of cathodic arc evaporation and direct current magnetron sputtering were used for deposition of TiN-Cu coatings onto NiTi archwires. The sample morphology was analyzed by FESEM, while chemical composition was assessed using EDS, XRD and FTIR. Ion release from the samples was estimated using ICP-OES. Cytotoxicity of the samples was investigated using MTT assay and antibacterial activity was tested against *Streptococcus mutans* and *Streptococcus mitis* bacterial cultures.
Physicochemical characterization of the coated archwires confirmed the presence of TiN phase with incorporated Cu. TiN-Cu coated archwires showed a statistically lower Ni release, higher relative cell viability and greater decrease in *Streptococcus mitis* concentrations, in comparison to non-coated ones. These results make TiN-Cu coated archwires a good candidate for further clinical investigations.

P9

Graphene oxide-modified cementitious composite materials

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Given that cement composites, which include cement and mortar, are currently the most extensively used building materials, their strength and durability are exceptionally important. Recent developments in unique nanoscale fibers, such as graphene oxide and carbon nanotubes, have created new avenues for improving the performance of cement composites. Graphene oxide is a two-dimensional planar sheet of compressed carbon atoms in a honeycomb structure that is a sp2-hybridized single-atomic-thick carbon allotropic building block (thickness 0.335 nm). With its unique features and enhanced performance, graphene oxide is a promising nanomaterial. Because of its exceptional mechanical, optical, thermal, and transport characteristics, it has drawn attention worldwide. Customizing the properties of cementitious composites using graphene oxide nanomaterials enhances their mechanical performance, durability, self-healing, and other multifunctional qualities, in addition to controlling the secondary hydration mechanism. The

outstanding and unique performance of GO is demonstrated by its ability to increase gel pores, decrease bigger capillary pores, bridge microcracks and prevent their propagation, and improve the overall performance of cement composites. This study presents a substantial investigation of the functioning of cement composites reinforced with graphene oxide nanomaterials. Four composites have been prepared based on different cement types: ordinary Portland cement, CEM III, alumina cement, and high alumina cement. Graphene oxide was added in quantities of 2, 4, and 6 wt.%. Hydration routes were analyzed by differential thermal calorimetry. Potential changes in mineral phase composition were investigated by means of X-ray diffraction analysis. Alternations of the microstructure have been assessed by scanning electron microscopy.

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P10

The innovative method for determining the approximate value of the Bond work index

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In this study, we examine an innovative approach to determining the Bond work index, a key parameter in the mining and cement production industry that indicates material grindability. The method relies on the first-order kinetics law and allows for the estimation of approximate index values with any number of grinding cycles, depending on the desired data accuracy. An important aspect of this approach is the multiplication of parameters G and P_{80} for each cycle by specific coefficients, achieving values close to those of the last grinding cycle when equilibrium is reached in the standard test. In this paper, we compare the results obtained by the innovative method with the standard Bond procedure on various samples of mineral materials. Our analysis shows a significant reduction in the mean square error as the number of grinding cycles increases, indicating increased precision of the new approach.

P11

Feasibility study on utilization of pulverized construction and demolition waste as alternative raw material for Portland cement clinker production

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A number of beneficial characteristics are displayed by ordinary Portland cement (OPC), including workability, appropriate setting and hardening behavior, superior mechanical performance, and good chemical resistance. OPC has been used as the major bonding agent in the building industry for more than 200 years due to these reasons. OPC is commercially produced by heating limestone, quartz, clay, and slag in a specially designed rotary kiln. The goal of this study is to use waste materials (construction and demolition waste) and alternative clayey materials to produce cement clinker. When it comes to the resources needed to make cement clinker, caution has been applied because substitute raw materials need to be accessible in adequate quantity and quality. Carbon dioxide is a byproduct of the chemical reactions in a rotary kiln. One kilogram of CO_2 is released into the atmosphere during the cement-making process. Up to 9% of global human CO_2 emissions are produced annually by the manufacture of cement and concrete. An attempt has been made to decrease the sintering temperature and the duration of thermal treatment in order to decrease the carbon emissions of the process. Therefore, in this study, cement clinker was synthesized at temperatures ranging from 1100°C to 1400°C upon mechanical activation of the raw material. Four cement clinkers were produced based on different raw materials: 1) recycled concrete, kaolinitic-illitic clay, Fe-slag, and limestone; 2) recycled concrete, zeolite, Fe-slag, and limestone; 3) recycled concrete, bentonite, Fe-slag, and limestone; and 4) recycled concrete, refined kaolinitic-illitic clay, Fe-slag, and limestone. The obtained clinkers were characterized by DTA/DCS/TG, XRD, FTIR, and SEM methods. The results indicated that the obtained clinkers exhibited four main cement clinker phases, namely C_3S, C_2S, C_3A, and C_4AF, identical to commercial ordinary Portland cement (OPC). The obtained results pointed out that the production of cement clinker based on recycled waste resources and alternative clayey materials is feasible.

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P12

The influence of $NaHCO_3$ as a porogen on cobalt-carbon-smectite catalysts synthesis: characterization and application in Oxone® induced degradation of antibiotic

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Smectite rich bentonite clay (fraction containing particles up to 2 μm in diameter, from Bogovina, Serbia) was used as started material for catalyst synthesis. The intercalation of chitosan into the smectite structure was first step in the catalyst synthesis. The catalytically active species (Co^{2+}) was introduced by wetness impregnation method onto chitosan-smectite nanocomposite in the second step. Obtained cobalt-chitosan-smectite composite (Co/Ch-S) was mixed by $NaHCO_3$ in mass ratio 1:3, and the mixture was submitted to the carbonization process in an inert atmosphere of nitrogen at 500^0 C for 60 min. After carbonization process, the catalyst was rinsed by 1M HCl and distilled water until neutral reaction, dried and denoted as $Co/_{CA}$Ch-S. Characterization was performed by XRPD, XPS, SEM, and TEM methods. The $Co/_{CA}$Ch-S was tested in reaction of oxidative degradation of antibiotic ciprofloxacin in the presence of Oxone® as a source of sulfate anion radicals. The degradation of ciprofloxacin was monitored using UV-Vis spectrophotometry at wavelength of 277 nm within 240 min. It was found that 77% of ciprofloxacin was degraded after 240 minutes of the reaction using $Co/_{CA}$Ch-S catalyst.

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P13

Tailoring poly(dimethylsiloxane)-based polyurethanes for electronic applications: The role of MXene nanofillers

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Poly(dimethylsiloxane)-based polyurethanes (PUs) exhibit outstanding mechanical properties and biocompatibility, making them ideal for applications in electronic devices and medical implants.

The development of nanocomposites using PU as a matrix aims to tailor their properties for specific applications. MXenes, a novel class of 2D nanomaterials, are chosen as nanofillers due to their unique characteristics, including metallic conductivity, high specific surface area, mechanical strength, and the rich surface chemistry of their nanoflakes. In this study, we employed the *in-situ* polymerization method to fabricate PU/MXene nanocomposites by varying the MXene nanofiller content from 0.5 to 90 wt%, while maintaining a consistent soft segment content of 50 wt%. Thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), water contact angle (WCA), and mechanical testing (i.e. tensile test) were employed to examine the thermal behavior, surface hydrophilicity, and mechanical properties of the prepared nanocomposites. TGA results showed improved thermal stability of the nanocomposites compared to the pure PU, as indicated by the starting and ending temperatures of degradation. The DSC method indicated an increasing trend in glass transition temperature up to 5 wt%. Tensile test results revealed that the addition of MXenes increases the Young's modulus, while the elongation at break sharply decreases when 10 wt% of MXene is added. The addition of MXenes certainly enhances some properties, providing the opportunity to fine-tune the desired characteristics of the material, which is highly desirable for various applications, including flexible films for electronic applications.

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P14

Investigation of morphology of the polyurethane/TiO_2 composites

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Two series of polyurethane (PU) composites based on poly(ε-caprolactone), aliphatic hyperbranched polyester, isophorone diisocyanate and different content (0.5, 1 and 2 wt.%) of unmodified or surface-modified TiO2 nanoparticles were prepared. For the surface modification of TiO2 nanoparticles lauryl gallate was applied. Neat PU and composites were prepared by a two-step solution polymerization method, using sonification in an ultrasonic bath for composite fabrication in order to achieve homogenous distribution of nanoparticles, added in the first step of polymerization reaction. Morphology of prepared neat PU and its composites were investigated by utilizing scanning electron microscopy (SEM) and atomic force microscopy (AFM).

According to the obtained SEM micrographs, neat PU has compact and uniform cross-sectional morphology, while in the structure of its composites small voids and certain micro-structures, such as clusters or aggregates, can be observed. Furthermore, SEM-EDS measurements confirmed the presence of Ti atoms in composites, originating from the incorporated

nanoparticles. AFM analysis showed the existence of microphase separated morphology on the surface of PU and its composites. Moreover, the surface of both series of composites became rougher with the addition of nanoparticles, and its roughness increases with increasing amount of TiO2 nanoparticles. Prepared PU composites may have potential application as coatings.
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P15

Sintering process in dentistry

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The importance of sintering is explained in this abstract, with a focus on how it helps achieve the precise fit, structural stability, and natural aesthetics that are necessary for dental restorations to be effective. A crucial method in the creation of dental prostheses, especially dental bridges, is the sintering process. Through a regulated heating procedure, dental ceramic particles are fused together to create a final product that is both visually beautiful and extremely durable. The ideal mechanical qualities, such as strength and biocompatibility, are ensured by the high-temperature amalgamation of ceramic particles. A dimensional examination of the collected dental samples can be carried out by the 3D scanning process, and a comparison with the 3D models that served as their foundation is made. The 3D scanner used in this research is the Atos Core 200, while the comparison with the 3D model was made in the GOM Inspect program (GOM Metrology GmbH, Braunschweig, Germany). Based on the measurements obtained by 3D scanning, the average deviations characteristic of individual technological processing procedures were obtained. This approach enabled more precise model-making and savings on materials.
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P16

Effect of 2-Micron Particle Size of bentonite from the Bogovina deposit on the Briggs-Rauscher oscillatory reaction

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It is known that the Briggs-Rauscher (BR) oscillatory reaction is extremely sensitive to external influences, as well as to the addition of insoluble materials, such as bronze and clay. In this paper, the influence of bentonite from the Bogovina deposit on the Briggs-Rauscher reaction was examined. The particle size of bentonite clay was ≤ 2 μm. Different masses of bentonite clay were added 3 minutes before the start of the BR reaction. It was found that increasing the bentonite clay mass increases the oscillatory period up to a certain maximum value. A further increase in the mass of bentonite clay resulted in a reduction of the oscillatory period and eventually a complete cessation of oscillations. Based on the graph of the dependence of the oscillatory period on the mass of added bentonite clay, a pair (m_{max}, τ_{max}) was obtained that corresponds to the maximum added mass of bentonite clay that has the maximum period of oscillation.

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P17

The Influence of Mn and Fe dopants on the Structure Evolution, Electrical and Magnetic Properties of Mechanically Activated $SrTiO_3$ Ceramics

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The research was focused on the influence of manganese (Mn) and iron (Fe) incorporation at Sr and/or Ti sites on the microstructure, dielectric permittivity and magnetization of strontium titanate ($SrTiO_3$) ceramics. A solid-state method was used for the preparation of mechanically activated (10, 30 and 120 min) Mn- and Fe-doped $SrTiO_3$ ceramics with various manganese dioxide (MnO_2) and iron(III) oxide (Fe_2O_3) weight percentages (1.5, 3 and 6 wt%). X-ray diffraction (XRD) analysis showed the presence of structure distortion due to ion substitution which causes changes in lattice parameter (*a*). Microstructural analysis showed that the sample

activated for 120 min had the highest degree of homogeneity with the highest density values (5.03 gcm^{-3} for 1.5% MnO_2 and 4.75 gcm^{-3} for 6 wt% Fe_2O_3). Also, 120 min activated sample showed multiferroic behavior, as a consequence of the dominant incorporation of Mn/Fe ions at Sr/Ti sites in the structure, where magnetic properties are induced by doping without significantly impairing the dielectric properties. Based on all the above, it can be said that by doping $SrTiO_3$ with an optimal amount of dopant such as manganese/iron, including mechanical activation as an auxiliary process in doping, an important evolution of the structure can be achieved, which significantly affects electrical and magnetic properties. It was found that under optimal conditions, the magnetic properties of the starting $SrTiO_3$ material can be enhanced without significant impairing of dielectric properties.

P18

The effect of cobalt source and heat treatment atmosphere on efficiency of Co-based clay catalyst on Acid Yellow 23 degradation in Fenton-like process

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The degradation of Acid Yellow 23 (AY23) was investigated using Fenon-like oxidation reaction in the presence of Oxone® as a source of reactive sulfate-anion radicals. The self-activation of Oxone® is slow process, therefore various Co-based oxide-composites are used for its activation. In our study, four heterogeneous Co-based catalysts were synthesized using smectite clay (Gadžin Han deposite, Serbia). The 2μm fraction of clay was submitted to simultaneous intercalation with inorganic cations (Al-Keggin) and organic cations (hexadecyltrimethylammonium-$HDTMA^+$) and impregnated with Co^{2+} using two different salts ($(CH_3COO)_2Co$ and $Co(NO_3)_2$). The obtained hybrid composites were subjected to carbonization/calcination process at 500 ^{0} C alternating argon and oxygen atmosphere. The UV-VIS spectroscopy was applied to monitor the concentration of AY23 during the degradation process at λ_{max}=426 nm. The results showed that the source of Co^{2+} (type of salt) as well as the applied carbonization/calcination atmosphere played important roles in the catalyst efficiency. The best catalytic performance was obtained for the catalyst where cobalt is derived from $(CH_3COO)_2Co$ and which is carbonized under argon atmosphere, achieving 70% of AY23 degradation in 4 h. On the other hand, catalyst obtained from nitrate salts and calcinated under oxygen atmosphere led to degradation yield under 20%.

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P19

Phosphate Tungsten Bronze Doped with Zn^{2+} ions: Synthesis and Characterization

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The tungsten bronzes exhibit interesting chemical, electrical and optical properties. Phosphate-tungsten bronzes (PWBs) were obtained by thermal treatment of heteropoly compound 12-tungstenphosphoric acid ($H_3PW_{12}O_{40} \times nH_2O$) and their salts ($PWA \times nH_2O$; n = 29, 21, 14 and 6). In this work, the metal element zinc was used to dope 12-tungstenphosphoric acid ($H_3PW_{12}O_{40} \times nH_2O$), whereby a salt of heteropoly acid ($Zn^{2+}HPW_{12}O_{40} \times nH_2O$, Zn-PWA). Zn-PWA was then subjected to thermal analysis TGA/DTA to determine the phase transition of the heteropoly acid salt in the novel phosphate tungsten bronzes doped with zinc (ZnPWB). The temperature phase transition occurs at a temperature of about 600 ^oC. Characterization of newly obtained material was performed using Fourier transform infrared spectroscopy (FTIR), X-ray powder diffraction (XRPD), scanning electron microscopy (SEM) and cyclic voltammetry, which confirmed thermal transformation and the formation of Zn doped bronze. The obtained results open new directions of Zn-PWB research as a potential electrode material, as a catalyst for the reduction of oxygen in acidic electrolytes, due to the specific color and its thermal stability, Zn-PWB could also be used as a pigment.

P20

Sintering of ZnO, $ZnTiO_3$, and $(YCd)_2O_3$ ceramic powders by spark plasma sintering

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The main aim of this work is the study of the compactification of nano-sized semiconductive powders of ZnO, $ZnTiO_3$, and $(YCd)_2O_3$ using an advanced spark plasma sintering (SPS) technique. The compacting/sintering process was carried out at a relatively low temperature of 1000 °C and pressure of 50 MPa at 10 min of dwelling time in a vacuum. The samples prepared

by this approach were characterized in detail both before and after sintering by SPS: crystallinity and phase composition were determined by the combination of XRD and Raman spectroscopy, thermal stability was analyzed by differential scanning calorimetry (DSC/TG), and, structural characterization was carried out by the electron microscopy. At the same time, mechanical properties were evaluated by micro-nano indentation.

P21
Electrochemical Sensing of Doxorubicin on ZnO/GO Modified Screen-Printed Electrodes

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Electrochemical sensors (ECS) are increasingly acknowledged for their superior capability in detecting and monitoring environmental pollutants, offering distinct advantages over conventional analytical methods. The essential performance parameters of ECS, including selectivity, sensitivity, response time, and portability, can be significantly enhanced through the modification of bare electrodes. A variety of materials, such as noble metals, metal oxides, polymers, and diverse carbonaceous substances, have been employed to optimize these sensors for improved analytical performance.

The aim of our study was to modify screen-printed electrodes with a zinc oxide and graphene oxide (ZnO/GO) composite particles and test such prepared electrodes as an electrochemical sensor for detecting the anticancer drug doxorubicin (DOX) as water pollutant. The ZnO/GO composite, with 0.005 wt% of GO, was synthesized by microwave processing of precipitate. The physicochemical characteristics of the ZnO/GO composite was analyzed using X-ray powder diffraction (XRD), Raman and Fourier transform infrared (FTIR) spectroscopy, field emission scanning electron microscopy (FESEM), UV-Vis diffuse reflectance spectroscopy (DRS), and photoluminescence (PL) spectroscopy. Cyclic voltammetry (CV) was applied for electrochemical quantification of DOX using three different types of screen-printed electrodes: Au, Pt, and C. The ink was prepared by mixing 10 mg of composite material and 1.5 mg carbon black with 40 μL of 5% Nafion solution, 225 μL ethanol, and 225 μL water. CV was performed in 25 mL of phosphate buffer (0.1 M, pH = 7.0) with the addition of doxorubicin infusion solution (Ebewe Pharma, 50 mg DCF / 25 mL) in a portion of 10 μL to completely 160 μL. All measurements were done in a potential window of -0.4 – 0.6 V at a scan rate of 50 $mV \cdot s^{-1}$. The best activity, gained when screen printed carbon electrode was modified and used as ECS, was correlated with physicochemical characteristics of the ZnO/GO composite and discussed.

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pollutants detection by ZnO-modified electrochemical sensors: From computational modeling via electrochemical testing to real system application – WaPoDe.

P22

Cavitation resistance of refractory coatings

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In this study, the resistance to the cavitation effect of three types of refractory samples based on talc with the addition of 10%, 15% and 20% cordierite was investigated. Talc has a fine structure, low hygroscopicity, insensitivity to temperature changes, low coefficient of thermal conductivity, low coefficient of linear thermal expansion, great ability to stick and coat surfaces, good grindability, low hardness. Cordierite has high refractoriness, high hardness, high density, low value of dielectric constant, low coefficient of thermal conductivity, low coefficient of linear thermal expansion, high resistance to thermal shock, relatively high melting temperature with the possibility of application up to 1380°C, high inertness towards liquid metal. Cordierite was added in order to improve properties, primarily to increase resistance to the effect of cavitation. The prepared mixtures of refractory powders were pressed under a pressure of 1 MPa and sintered at 1200°C.To evaluate the cavitation resistance properties of the investigated refractory samples, the ultrasonic vibration method with a stationary sample was applied. The change in the mass of the samples as a function of the cavitation time was monitored and the cavitation speed was determined. The formation and development of damage to the surface of the samples was monitored using a scanning electron microscope. The mechanism of degradation and resistance to the effect of cavitation of the tested samples was monitored by measuring the mass loss and morphological analysis of the pits formed on the surface of the tested samples. Research has shown that the addition of cordierite in the composition of the tested samples based on talc significantly improves the properties of resistance to the effect of cavitation.

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P23

Efficient Adsorption of Methylene Blue and Rhodamine B by SBA-15 Materials: Implications for Wastewater Treatment

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Dyes pose a significant environmental problem due to their widespread use in industry. Their discharge into water bodies can affect aquatic ecosystems and cause human health issues. Efficient removal of dyes from wastewater is crucial to mitigate these adverse effects. Mesoporous silica materials SBA-15 were investigated as adsorbents to remove methylene blue and rhodamine b dyes. It was found that modifications of the synthesis conditions (the temperature and the duration of the synthesis reaction) affected the significant morphological differences of the synthesized SBA-15 materials and their ability to remove the mentioned dyes. Employing a dosage of 5 mg dm^{-3} at 22 °C, with a 60-minute contact time, it was found that rhodamine b showed 2 to 3 times higher adsorption capacity on both materials compared to methylene blue. Furthermore, SBA-15/100 demonstrated 2 to 4 times greater adsorption efficiency for both dyes than SBA-15/80. These results underscore the potential of SBA-15 materials as efficient adsorbents for dye removal, contributing to the advancement of sustainable solutions for environmental remediation.

P24

Improving the phase detection using machine learning approach: $Y_2MoO_6:Eu^{3+}$ at high pressures

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The Eu^{3+} activated Y_2MoO_6 ($Y_2MoO_6:Eu^{3+}$) powder was prepared by the self-initiated and self-sustained reaction method. After synthesis, in order to achieve the full crystallinity, the material was calcined at different temperatures. Phase identification in the post-calcined powder samples were performed by X-ray diffraction (XRD), and morphology was investigated by high resolution scanning electron microscope (SEM) and transmission electron microscope (TEM). Photoluminescence characterization of emission spectrum was obtained using Ocean optics spectrometer and laser diode excitation at 405 nm. High pressure dependence of $Y_2MoO_6:Eu^{3+}$ emission spectrum was acquired and used to determine the pressure dependent curve based on intensities of two prominent peaks. The phase transition is clearly observable by visual inspection of such obtained curve. Here, we show that further improvements in phase transition detection

are possible by using the machine learning approach. To facilitate the visual data assessment, we have incorporated The Principal Component Analysis (PCA), t-Distributed Stochastic Neighbor Embedding (t-SNE) and Uniform Manifold Approximation and Projection (UMAP) clustering of $Y_2MoO_6:Eu^{3+}$ spectra at various pressures.

P25
Non destructive testing (NDT) of building materials mechanical properties

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Non-destructive testing methods in the construction industry enable the assessment of material properties without causing any damage. One of the commonly used methods for mechanical testing of building materials is the 3-point measurement and compression test, which both are destructive to the material. To avoid the use of destructive methods and simplify materials testing, some non-destructive methods are used to determine mechanical properties by connecting materials' internal structure, defects, pores or cracks, with the mechanical characteristics of materials.
One of the most used techniques for such testing is Ultrasonic Pulse Velocity (UPV) which uses ultrasonic waves to analyze the internal structure of materials. This study aimed to measure the ultrasonic pulse velocity to assess the mechanical properties of building materials. Used samples were cement mortar, stone material and elements of earthen architecture - clay blocks with carbolime. To support and test the accuracy of UPV analysis, the mechanical properties of these materials were examined, and by correlation and regression analysis, equations were obtained for evaluating the mechanical properties. As a result, it was shown that there is a correlation between pulse velocity and mechanical properties. However, to obtain more efficient regression equations, further research with a larger number of samples is necessary.
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P26 Poster Session II
Rod-Shaped α-Bi_2O_3: A Novel Electrode Material for Electrochemical Sensing of Acetaminophen in Pharmaceutical Formulations

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A modified reverse co-precipitation method using glacial acetic acid to synthesize α-Bi_2O_3 structures is presented. The formation of an almost pure rod-like α- Bi_2O_3 microstructure was confirmed by X-ray powder diffraction and scanning and transmission electron microscopy analyses. A glassy carbon paste (GCP) electrode was modified with the obtained material in aim of development of an electrochemical sensor for acetaminophen (APAP) detection using differential pulse voltammetry (DPV). Cyclic voltammetry revealed better performance of the GCP@Bi_2O_3 electrode in comparison to the bare GCP. The prepared GCP@Bi_2O_3 sensor successfully detected APAP in the linear concentration range from 0.05 to 12.00 μM, with the limit of quantification (LOQ) and the limit of detection (LOD) of 36 nM and 10 nM, respectively. Furthermore, the designed sensor showed pronounced precision, repeatability, and selectivity toward APAP detection. The GCP@Bi_2O_3 sensor and associated DPV method demonstrated high accuracy, precision, and practical utility for real-time APAP quantification in pharmaceutical products like Caffetin®. A comparison of declared and measured APAP levels revealed excellent recovery rates, with minimal impact from other formulation components.

P27
Characterization of laser-induced graphene on PDMS/Triton composites

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Three-dimensional porous laser-induced graphene (LIG) has recently emerged as a promising material in the physical, chemical, and engineering fields due to its high carrier mobility, large surface-to-volume ratio, high porosity, and superb mechanical properties. The LIG technique is considered cost-effective and environmentally friendly; hence, LIG has been explored for various applications, including energy storage, electrocatalysis, sensing, and flexible electronic devices. However, despite considerable efforts to develop LIG on new polymer substrates, there remains a scarcity of stretchable polymers suitable for laser graphenization. In this work, LIG production on novel flexible poly(dimethylsiloxane) (PDMS)/Triton composites has been successfully done for the first time via single-step CO_2 laser irradiation in ambient air. We determined the optimal laser parameters (power, resolution, and scanning speed) for LIG of PDMS/Triton composites. The influence of Triton concentration (1-30 wt.%) on the structural, nanomechanical, thermal, surface, and electrical resistance characteristics of LIG/PDMS/Triton materials was examined. These materials were characterized using X-ray diffraction analysis (XRD), nanoindentation measurements, water contact angle analysis, and thermogravimetric analysis (TGA) in both oxygen and nitrogen atmospheres. XRD analysis confirmed the formation of LIG on PDMS/Triton surfaces. Thermal investigation under different atmospheric conditions showed that Triton concentration affects thermal stability and degradation characteristics of PDMS/Triton

composites. PDMS/Triton composite films were more thermostable in nitrogen than in oxygen, while the presence of graphene further improved thermal stability, contributing to the composites' suitability for high-performance applications in flexible electronics. Notably, our LIG/PDMS/Triton materials exhibit robust mechanical properties, favorable thermal characteristics, and super-hydrophobic surfaces, showcasing significant potential for applications in flexible electronic devices.

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P28

Lanthanide-doped bioglass for non-specific cell labelling

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Bioglass is glassy ceramic biocompatible material, usually composed of silicon, calcium, phosphorus and sodium oxides. As such, it has a great potential for application in bone tissue engineering. If it possessed optically and magnetic features too, it would allow unambiguous and non-invasive tracing of bone defects reparation process. For this purpose, we prepared bioglass doped with different combinations of rare earth elements that should enable multimodal imaging in biomedicine: ytterbium/erbium/gadolinium and europium/gadolinium. After confirmation of phase composition of synthetised bioglass, luminescent measurements were performed. As expected, ytterbium/erbium/gadolinium-doped sample showed up-conversion properties, emitting visible blue, green and red light when excited by NIR laser, while europium/gadolinium-doped sample showed down-conversion features, by emitting red visible response induced by excitation with UV laser. Cytotoxicity tests implied that lanthanide-doped bioglass particles are non-toxic, and safe to use in hard tissue engineering, while their successful visualization in cells by laser scanning and inverted-fluorescence microscopy confirmed their cell labelling capacity.

P29

Cavitation resistance of chromium-nickel tool steels obtained by hot isostatic pressing

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The paper presents the results of research into the cavitation resistance of tool steels obtained by the process of hot isostatic pressing. The compositions of the powder mixture for pressing, as well as the parameters of the HIP process, primarily temperature and pressure, were investigated. The pressing temperature ranged from 1000-1150°C, the pressing pressure was 100 to 300 MPa, and time was 3-4 hours. These steels are used for the production of equipment parts in metallurgy, mechanical engineering and mining. The cavitation resistance of three series of steels with different nickel and chromium content was tested using the ultrasonic vibration method with a stationary sample according to the ASTM G32 standard. The reduction of the nickel content in the composition of the steel has a favorable effect on the development of the martensitic transformation and the increase in the hardness of the steel. The presence of chromium improves the mechanical properties and chemical stability of steel. The obtained cavitation speeds below 0,11mg/min indicate a good cavitation resistance of the samples and the possibility of application in conditions of exploitation where the presence of cavitation, corrosion and wear is expected.
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P30

New protective coatings based on pyrophyllite and zirconium silicate

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The paper presents the results of the synthesis and characterization of refractory coatings based on pyrophyllite (80%) and zirconium silicate (20%) with a binder based on epoxy resin intended for the protection of metal and non-metal constructions and parts of equipment in industry. Samples of refractory fillers were subjected to micronizing grinding to the filler grain size: pyrophyllite 20μm and zirconium silicate 15μm. This achieved a good alignment of the filler particles with each other. XRD, SEM, and optical microscopy methods were used to characterize the obtained fillers. The optimal composition of protective coatings and the procedures for their production were determined by testing. The ultrasonic vibration method with a stationary sample according to the ASTM G32 standard was used to characterize the obtained coatings. The aim of the test was to determine the quality of the coating and the possibility of application for the protection of metal surfaces in conditions of wear, corrosion, cavitation, and elevated temperatures. The quality of the coating was evaluated based on the value of the cavitation speed and the analysis of the formation and development of damage to the surface of the samples under the effect of cavitation. Based on the measurement of mass loss during the test under the effect of cavitation, the cavitation speed was determined (V = 0.31 mg/min), and the morphology of the damaged surfaces was analyzed by recording the surface of the coating on a scanning electron microscope. It was established that mass losses and the formation of pits on the surface of the coating were small and that the surface damage was 16.5%, which shows that the tested coating samples have satisfactory cavitation resistance. The tested coatings based on pyrophyllite and zirconium silicate can be applied to protect metallic surfaces in conditions where moderate cavitation effects are expected.

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P31

Graphitic carbon-nitride band-potentials tuning by oxygen doping

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Graphitic carbon-nitride (g-C_3N_4) as a natural polymer and a metal-free indirect band-gap material attracted great attention in the last decades. With the bulk band-gap energy of about 2.7 eV, it is capable to harvest visible light photons making it suitable for application in the photocatalytic pollutant degradation, energy conversion and photocatalytic hydrogen production. While the potential of the conduction band of g-C_3N_4 is at about -1.3 V (vs. NHE) and well suited for production of the superoxide anion radicals ($O_2^{\bullet-}$, -0.33 V vs NHE), valence band potential is at about +1.4 V (vs. NHE) making it uncapable of producing hydroxyl radicals ($OH^{\bullet}$, +2.8 V vs NHE), the main radical species for the organic matter degradation.
In this study, graphitic carbon nitride was modified by oxygen doping. Influence of the oxygen incorporation in g-C_3N_4 structure on its electrochemical properties is tested by cyclic voltammetry and electrochemical impedance spectroscopy. Flat-band potentials of the parent and modified compound are determined from Mott-Schottky plots. Obtained values are used to calculate valence and conduction band potentials of the doped samples, revealing that oxygen doping resulted in the significant shift of the valence band potential towards more positive values.
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P32

Natural minerals and its influence on pH values of contaminated solutions

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Radionuclides such as lead, zinc, uranium and cadmium are major pollutants of agricultural areas. In order to ensure the cultivation of healthy food, it is necessary to controle the mobility of these heavy metals. The elimination of this elements with natural mineral raw materials such as zeolite and apatite is extremely important from the aspect of health protection and healthy food

production. Aim of this research was to determining the possibility of apsorption of mineral raw materials of heavy metals. The investigation was performed in columns under constant pressure with two pH values (5.0 and 7.0). The concentration of heavy metals was 300 mg/l. The absorption monitoring time was 30, 60, 90, 120 and 180 min. Results showed a significant change pH value of the filtrate as a function of the absorption time. It was found that both apatite and zeolite significantly immobilized lead at both filtrate pH values. Uranium immobilization was better performed in columns with apatite, zeolite showed better properties in cadmium immobilization, and tests on a solution contaminated with zinc showed that both apatite and zeolite show similar affinity. The obtained results were statistically processed using the method of two-factor analysis of variance with repeated measurements.

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P33

Investigation of the possibilities of applying limestone in agriculture and its geological characterization

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Geological investigations have shown that a large carbonate series is plased in the atar of the village of Tršić, east of Loznica. This limestone deposit (Dobrilovići) is rich, and geological tests have shown that the quality of the limestone is satisfy for applying in agriculture. Also, large reserves of limestone are placed which enable long-term exploitation. Limestone found its aplication In agriculture for calcification of acidic agricultural soils with an average pH value of 3.5 to 5. For this purpos, a certain dimensions and chemical composition of limestone is suitable for uses. Chemical analysis of the sample from this deposit showed the presence of CaCO3 above 80% and CaO above 44.80%. Traces of lead, nickel and chromium were found in the deposit (Pb 3 mg/kg, Ni 7 mg/kg and Cr 21 mg/kg). The pH value of limeston was 8.47, while the loss on ignition was 39.40%. Based on the obtained results, it was concluded that the mineral and chemical composition of limestone is suitable for calcification of acidic soils. The granulometric composition of the sample showed the presence of large classes above 50 mm (68%). Calcification of acidic soils is carried out with a class of 100% -2 mm. A scheme for the preparation of trench limestone is given, which includes crushing, grinding and grading.

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P34

Adsorbers based on zeolite formed by plasma electrolytic oxidation

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Oxide coatings are prepared by conventional DC plasma electrolytic oxidation (PEO) of AA2024 aluminum alloy in water solution of boric acid (H_3BO_3) and borax ($Na_2B_4O_7 \cdot 10H_2O$), with addition of Zn-loaded ZSM5 and Y synthetic zeolite in different concentrations. In addition, a set of oxide coatings with co-deposited ZnO nanoparticles, ZSM5 and Y zeolite from the same electrolyte is prepared. Scanning electron microscopy equipped with energy dispersive X-ray spectroscopy, X-ray diffraction, and AFM imaging are employed to monitor morphological, structural, and chemical changes of obtained oxide coatings. It was found that chemical and phase compositions strongly depend on PEO time. Photoluminescence measurements showed that clearly observable bands inherent to Al_2O_3 and ZnO are present in formed coatings, pointing at oxygen vacancies. The optimal concentration of species in the electrolyte for achieving the best adsorption performance of the coatings has been determined. The study showed an exceptional adsorption capacity of the combined Zn-ZSM5 and Zn-Y coatings. Specifically, the best-performing coatings achieved approximately 90% adsorption of methyl orange within six hours.

P35

Experimental Investigation of Elastic Modulus of Ultra-High Performance Concrete on Small-Scale Specimens

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Modulus of elasticity of concrete and other cement-based materials is experimentally obtained through a static load test, which generally involves cyclic preloading in the elastic range, before recording the final measurements of force and deformation. Due to heterogeneity of concrete, certain minimal size of a specimen is needed. This requirement is addressed in relevant standards, where specimen sizes are prescribed. Ultra-high performance concrete (UHPC) mixes contain fine quartz aggregates, which may permit a smaller specimen size, such as those used with mortars, which would reduce costs and waste associated with laboratory testing, while retaining satisfactory confidence in results. In the investigation presented in the paper, testing procedure for concrete was modified to accommodate a smaller specimen size (40x40x160mm prism) and used to obtain the stabilized elastic modulus of three UHPC mixes with varying amount of steel

fiber reinforcement. The results exhibit a relatively small dispersion and a reasonable agreement with dynamic moduli obtained by pulse velocity method. To validate the results, a numerical investigation is carried out to examine the influence of imperfect specimen geometry on strain readings. Technical aspects of the testing method, potential improvements and prospects of application to other fine-grained cement-based materials are outlined and discussed.

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P36
Catalytic performance of cobalt impregnated pseudo-boehmite in degradation of tartrazine in the presence of peroxymonosulfate

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Commercial pseudo-boehmite was impregnated with the cobalt nitrate solution using the incipient wetness method. 3 mas% and 6 mas% of Co^{2+} was used, followed by calcination at 500 °C to obtain catalysts with gamma phase of alumina. The catalysts were investigated in a peroxymonosulfate-induced Fenton-like process of tartrazine dye degradation. The effect of reaction temperature was tested, and it was found that the reaction rate increased with temperature elevation. The catalyst with 6% of Co^{2+} was proven to be much more effective in the investigated reaction. The common kinetic models were applied and pseudo-first-order kinetic model was found the most appropriate. Calculated energy of activation was about 85 kJ/mol for both catalysts. The effect of scavengers was also investigated to identify the dominant reactive oxygen species. Tert-butanol only slightly inhibited the reaction, while with ethanol, reaction rate more significantly decreased. This indicated that sulfate anion radicals are the dominant reactive oxygen species.

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P37

The effect of coexisting anions in Fenton-like Orange G degradation using cobalt-based alumina catalysts

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Real wastewater usually contains various inorganic ions. It is important to investigate the influence of coexisting ions on the degradation process when examining the effectiveness of a catalyst in dye degradation since they can affect the reaction process. Two cobalt-based aluminas were tested in oxidative degradation of Orange G (OG) dye in the presence of Oxone®. The catalysts were obtained using sol-gel method, followed by gelation and calcination at 1000 ºC and 1100 ºC. In this work the effects of most common anions present in real waters: Cl^-, HCO_3^-, NO_3^-, SO_4^{2-}, $H_2PO_4^-$ on OG degradation was investigated. Also, the effect of cations K^+, Mg^{2+} and Ca^{2+} was tested. It is noticeable that some anions speed up and other slow down the degradation of OG, while all investigated cations had the positive effect on the reaction rate. It was shown that anions Cl^- and $H_2PO_4^-$enhanced the OG degradation rate, while NO_3^-, SO_4^{2-} and HCO_3^- inhibited it. It is concluded that the overall effect of coexisting ions is complicated and depends on many factors, such as the type of ions, the concentrations of each species etc.
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P38

Required quality parameters of clay for its further application

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Clays are used in various industries such as: ceramic industry, porcelain (kaolinite clay), refractory industry for making molds (montmorillonite clay), while clays with an increased content of impurities are used in pottery. Each user has their own clearly defined quality requirements that this raw material must meet. The quality of clay is determined by its chemical and mineralogical composition, and the presence of impurities. They are made of finely dispersed particles and their composition includes silicate type minerals. They consist of one or more main minerals (kaolinite, hydroliskuni-illite, montmorionite and other aluminum silicates) and various impurities that can limit its further application (quartz, zircon, apatite, garnets, iron carriers and others). Silicates that are an integral part of clay can be crystalline (group of kaolin, pyrophyllite, montmorionite, illite and halloysite) and amorphous (alophane). Phyllosilicates are representatives of the crystalline group. They contain silicon, aluminum and significant amounts of water. Differences in mineral composition are mainly due to different proportions of silicon

and aluminum. The article shows the basic characterization of clay, on the basis of which the quality of the trench raw material is determined. The obtained results are the basis for designing a suitable preparation procedure in order to obtain a product of a more satisfactory quality for further use (eg iron removal is done by magnetic separation).

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Intergranular capacitance of sintered $BaFe_{12}O_{19}$ doped with TiO_2 at very low frequency region

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A powder of $BaFe_{12}O_{19}$ composition (barium hexaferrite) was prepared by using the respective mixture of metal oxides and solid-state reaction at 1000 °C/4h in air. The obtained barium hexaferrite powder was milled for a prolonged time in the planetary ball mill and agate mill to achieve submicron powder. The $BaFe_{12}O_{19}$ submicron powder was mixed with TiO_2 nanopowder as a dopant. The prepared powder mixture was characterized by using XRD and SEM techniques. After that, the barium hexaferrite powder mixture was pressed into thin and small diameter size disk-shaped samples and sintered at different sintering profiles from 1150 °C to 1275°C / 2h to 6h. The sintered samples were also characterized by using XRD and SEM. The main electrical properties such as capacitance (intergranular) and bulk resistance R at 1Hz to 100 Hz were measured at room temperature. The dielectric permittivity was calculated from the equivalent scheme of disk capacitor. The obtained results were used for observing space charge relaxation effects and development of multilayer capacitor for energy storage device.

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Laser-Induced Graphene on Novel Polyurethane Networks for Pulse Sensing Applications

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Wearable heart rate sensors are ubiquitous in today's market, enabling real-time monitoring for both fitness and health purposes. However, the adaptability of laser-induced graphene (LIG) sensors extends beyond conventional heart rate monitoring, offering a significant advantage in scenarios where mature competitive technologies fall short. In this study, we introduce heart rate sensors based on LIG integrated onto the surface of novel polyurethane (PU) networks comprised of α,ω-dihydroxy-poly(ε-caprolactone)-*b*-poly(dimethylsiloxane)-*b*-poly(ε-caprolactone), 4,4'-methylenediphenyldiisocyanate, and hydroxy-functional hyperbranched polyester. These PU networks exhibit exceptional mechanical properties and biocompatibility, which are crucial factors in the development of wearable sensor substrates. Heartbeats were measured utilizing LIG's piezoresistive properties. Graphene devices on PU substrates were connected to a pulse simulator and a Keithley 2450 Source Measure Unit for electrical measurements. Measurements were conducted in constant current mode, with the current set at 0.1 mA, while voltage was recorded over several minutes. We achieved spectra with satisfactory signal-to-noise ratios. The primary contribution of our work lies in demonstrating that the biodegradable nature of the prepared PUs enables the environmental friendliness of the sensor system. Furthermore, the straightforward fabrication process of LIG on PU networks eliminates the need for costly equipment or post-fabrication treatments, thereby further reducing environmental impact.

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Synthesis and characterization of praseodymium salt of 12-tungstophosporic heteropoly acid – Pr-PWA

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Praseodymium salt of 12-tungstophosphoric heteropoly acid – Pr-PWA has been successfully synthesized. For the preparation of praseodymium salt (Pr-PWA), as a starting material is used 12-tungstophosphoric heteropoly acid $H_3PW_{12}O_{40}\times 29H_2O$ (PWA). PWA is obtained by combining the aqueous solution of $Na_2WO_4\times 2H_2O$ with mixture containing H_3PO_4 and HCl. The precipitate was extracted with 40 ml of 11.5195 mol dm^{-3} HCl and 70 ml of ether. Afterward, PWA was transformed into $H_3PW_{12}O_{40}\times 6H_2O$ (6-PWA) by heating it to 80 °C in a kiln. The aqueous $PrCl_3\times H_2O$ solution was prepared by dissolving 0.7102 g $PrCl_3\times H_2O$ in distilled water. This solution is then mixed with aqueous solution of 6-PWA, slightly heated in order to start the crystallization process and left during the night to finish the crystallization. The synthesized Pr-PWA salt is then characterized by following techniques: thermal analysis (TGA and DTA), X-ray powder diffraction (XRPD) and Fourier transform infrared spectra (FTIR). Synthesized salt Pr-PWA can be successfully used as a precursor in the synthesis process of praseodymium doped phosphate tungsten bronze.

P42

Preparation of novel polyurethane networks for laser-induced graphene

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The development of wearable sensors based on laser-induced graphene (LIG) has recently attracted significant attention. For this application, LIG should be induced on flexible and biocompatible polymeric substrates. In this work, novel polyurethane (PU) networks based on

α,ω-dihydroxy-poly(ε-caprolactone)-b-poly(dimethylsiloxane)-b-poly(ε-caprolactone) (PCL-b-PDMS-b-PCL) prepolymer were prepared by a two-step polymerization procedure. The tri-block prepolymer contained terminal crystallizable PCL blocks and a central PDMS block. PCL is particularly interesting due to its properties such as excellent water resistance, slow hydrolytic and enzymatic degradation, good biocompatibility, and very high flexibility. The combination of the properties of PCL and PDMS makes this block co-polymer an excellent candidate for preparing PU as a biocompatible substrate for LIG. A series of four samples of PUs with different contents of soft segments (40-70 wt.%) were prepared for subsequent LIG production. We explored the direct induction of LIG on PU networks using CO_2 laser irradiation. Additionally, we investigated the possibility of producing LIG on a commercially available polyimide film with subsequent transfer onto PU films. LIG films were characterized using Fourier-transform infrared spectroscopy, Raman spectroscopy, scanning electron microscopy, and X-ray diffraction analysis. We identified the optimal chemical composition and laser processing parameters for LIG production to be applied in wearable sensors.

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P43

The application of the thin and lumped appreoach for comparision of the drying kinetic registered for various thin clay slabs

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The main goal of this paper was to compare the lumped and thin layer modelling approach for describing the drying kinetics of clay slabs extruded from various clays. Four drying regimes were firstly designed. The drying velocity was fixed to 3 m/s in all experiments. The drying temperature and humidity were hold at 40^0C and 60% in the first drying regime. These parameters were raised for 10^0C and 10% in each following experiment. Eight thin-layer models, including the new one, was used. The non-linear regression analysis was applied for fitting the experimental data. The lumped approach is relatively new and it assumes that different drying mechanisms which affects the internal moisture transport are combined and presented in a form of the effective diffusivity constant. The lumped modelling approach has retained and reused the form of the Crack's diffusion equation with only one update. The pure diffusion coefficient was replaced with the effective one. Since the effective moisture diffusivity can vary with time the most advanced lumped models are taking this into account by defining the relationship between the effective diffusivity coefficient and the Fourier number. This model was adopted in this

paper. Results have shown that the best thin layer model was the new one. It was found that this model has up to 5 % deviation from the experimentally registered data at the beginning of the first drying segment. The lumped model was deviating from the experimental data for only 2%. This was another confirmation that the conjugation degree in thin layer modelling is lower than in the case of the lumped approach. This means that thin layer model application is actually very limited, especially for porous materials which predominantly shrinks during drying, due to theoretical assumptions which simplifies the boundary conditions for which the equations were originally developed.

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P44

Effect of temperature treatments on microhardness of additively manufactured PETG

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The specimens were made using an additive technology. Polyethylene terephthalate glycol (PETG) filament was used as the primary material. Three series with nine different printing specimens (different printing parameters) were made. The Vickers microhardness (HV) of all specimens was tested. The temperature treatments of specimens were done in a mold with NaCl powder (230°C, 30 min), and in a chamber at low temperature (-200 °C, 30 cycles). It was observed that the HV values oscillated, depending on the printing parameters, temperature treatment, and locations. The microhardness was slightly higher on the bottom surface of the specimens than on the top surface. For untreated specimens, the average microhardness measured on the top and bottom surfaces was between 10.2 and 12.6 HV. For specimens treated in mold with NaCl powder, changes in geometry were observed, together with an increased microhardness of 11.0 to 13.5 HV. The treatment in a chamber at low temperature induced a decrease in microhardness, and the values were in the range of 9.0-9.5 HV. It is commonly recognized that the microstructural alterations in amorphous polymers are directly correlated with microhardness. In this connection, the basic idea is to show treatments that can significantly improve/degrade the mechanical properties of this material in daily use.

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P45

Assessment of the efficiency of photocatalytic degradation of the model pollutant Methyl-Orange in real environment

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Due to significant pollution and the presence of pollutants, there is an increasing demand for materials that enable self-cleaning of interior wall surfaces, particularly in areas with high foot traffic. To protect wall surfaces, a photocatalytically active suspension based on ceramic materials, doped with an optimal concentration of $(NH_4)_2WO_4$, was synthesized.
The photocatalytic suspension activity as well as the activity of the suspension in solid form later applied to the wall was confirmed using several methods (UV/VIS spectrophotometry, FTIR analysis, Scanning Electron Microscopy and colorimetric tests). LED light was used as the radiation source and Methyl-Orange was chosen as the model pollutant. The optimal concentration of the model pollutant was determined. After confirming the photocatalytic activity of the suspension applied to the wall, it was necessary to investigate the optimal number of suspension coatings on the wall (optimal amount of solid phase) that would ensure the best photocatalytic efficiency for degrading the model pollutant. Various numbers of suspension coatings were tested on the wall, and the model pollutant Methyl Orange was applied over them, with its degradation monitored under the influence of LED light. The efficiency of degradation was monitored using FTIR analysis (Fourier Transform Infrared Spectroscopy) and colorimetric tests. Measurements were taken at marked points on the wall, where different numbers of suspension coatings were applied, before and after exposure to LED radiation, after which the optimal number of coatings (the optimal amount of solid phase) necessary for efficient degradation, was determined.
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Transport Properties Of H_2^+ Ions In Ar Gas

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Cold plasmas are frequently used in new technologies where they open up the possibilities of non-intrusive production or modification of various substances. In this work we present a cross sections dataset and transport properties of H_2^+ in Ar gas. The ionic charge transfer reactions with

molecules are indispensable elementary processes in the modeling of kinetics in terrestrial, industrial and astrophysical plasma in the detection of dark matter. A Monte Carlo method is applied to accurately calculate transport parameters for the hydrodynamic regime. We discuss new data for H_2^+ ions in Ar gas where the mean energy, characteristic energy, flux and bulk values of reduced mobility, rate coefficients and other transport parameters are given as a function of low and moderate reduced electric fields *E/N* (*E*-electric field strength, *N*-gas number density).

P47

Cementitious Materials Enhanced with Biochar

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Control and mitigation of CO_2 emissions are now necessary due to the construction industry's increased carbon footprint. The preparation of raw materials, the manufacturing of cement, and most importantly the construction process all have an impact on CO_2 emissions in the construction industry. Therefore, incorporating biobased materials into cement may lower CO_2 emissions. Biobased raw materials, however, have the potential to deteriorate and impair cement performance. Any organic material that has been carbonized at high temperatures (300–1000°C) with little to no oxygen present is referred to as "biochar." This process (pyrolysis) produces gases and bio-oils in addition to a solid residue known as "biochar," which contains at least 80% elemental carbon. It has recently been shown that biochar, or carbonized biomass, can effectively substitute a part of the cement in mortar or concrete. Numerous studies have shown that adding biochar to cementitious materials improves mechanical strength and thermal characteristics. In order to fully understand the characteristics of cementitious materials infused with biochar, it is necessary to analyze the properties of biochar and how they affect these composites. In this study, mortar samples with biochar used as 10, 20, 30, and 50% cement replacement were prepared. Ordinary Portland cement and river sand were used in the experiment. Properties in fresh condition (bulk density, the flow table test for measuring the workability and consistency, the content of entrained air), on hardened samples (compressive, flexural, and splitting tensile strength, pull-off testing), and non-destructive testing (ultra-sound pulse velocity method) were employed on mortar specimens. With the use of differential thermal calorimetry, hydration routes were examined. X-ray diffraction analysis was used to look into any changes in the composition of the mineral phase. Scanning electron microscopy has been used to evaluate microstructure alterations. All things considered; the mechanical characteristics previously examined in the literature align with the microstructural alterations noticed. These findings underscore the necessity of meticulously adjusting the volume percentage of biochar to regulate its impact on the cementitious material microstructure.

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Effect Of The Erbium Content On The Structural, Morphological And Optical Properties Of Barium Titanate Ceramics

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In this work, the erbium (Er^{3+}) doped barium titanate ($BaTiO_3$) ceramics were investigated. Doped $BaTiO_3$ were prepared by using conventional method of solid-state sintering at 1320-1380 ºC for 4h. The obtained samples have been studied using a variety of characterization techniques: X-ray diffraction (XRD), Raman and infrared (IR) spectroscopy, photoluminescence (PL), scanning electron (SEM) and atomic force (AFM) microscopy. The investigated doped $BaTiO_3$ samples showed a typical tetragonal XRD patterns. EDS study confirmed the presence of Er^{3+} ions in the $BaTiO_3$. SEM analysis of $Er/BaTiO_3$ doped ceramics showed that in samples doped with a rare-earth ions low level, the grain size ranged from 20-40 μm, while with the higher dopant concentration the abnormal grain growth is inhibited and the grain size ranged between 2-10 μm. All of these ceramic samples exhibited a tetragonal perovskite structure, which implies that Er^{3+} ions were completely incorporated into the perovskite lattice. Based on the group theory analysis, the symmetry coordinates of the tetragonal $BaTiO_3$ were obtained and all the vibrational modes were presented by the linear combinations of symmetry coordinates. The A_1 and E modes are both Raman and IR active, while the B_1 mode is Raman active only. The results indicate that both of the microstructure and luminescence are found to be dependent on Er^{3+} substituting sites. Hence, these $Er/BaTiO_3$ can be used in display and optoelectronic devices.

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Advanced Chemical Analysis of Fly Ash Leachate and Mortars Using ICP-OES

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This study introduces a new approach using inductively coupled plasma optical emission spectrometry (ICP-OES) for the analysis of the chemical composition (34 elements: Al, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, V, Zn, Pb, Bi, Si, Zr, As, Hg, Se, Sb, Sn, Ti, Ba, B, Ag, Mg, Ca, K, Na, S, P, Li) of fly ash leachate, as well as mortars containing fly ash, zeolite, and bentonite. The method underwent rigorous validation and addressed measurement uncertainties. It offers an efficient way to detect traces of undesirable elements in fly ash leachate and in construction materials containing fly ash, zeolite, and bentonite, such as cement binders and mortars.

Laboratory testing of cement binders and mortars verified the accuracy and precision of the method, comparing results with standard limits. Multivariate analyses, including cluster and principal component analyses, were used to understand sample relationships and verification the developed ICP-OES method.

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Durable mullite bodies manufactured from waste diatomite

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Durable mullite bodies have been fabricated using diatom frustules from diatomite powder as Si and Al-nitrate as Al precursors with fibrous pore morphology. The hard mullite ceramics compacts were prepared by mold pressing without additives showed high compressive strength (up to 133 MPa at 1500ºC). The diatomite-nitrate samples were sintered at three temperatures (1300, 1400, and 1500ºC) for 2 h. XRPD of the sintered samples showed that the crystalline mineral phases mainly comprise mullite, cristobalite, and corundum. SEM results show the presence of rod-like mullite grains with 5 μm in length and 500 nm in diameter (aspect ratio 1:10). XRPD of the sintered samples at 1300ºC showed good thermomechanical stability and formation of new hard phases (mullite, corundum, and cristobalite) that makes the analyzed diatomaceous earth suitable for the production of various types of ceramic, construction, and thermal insulating materials.

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Reduced Fast Firing in the Ceramic Tile Manufacturing Process with Inorganic Additives: A Step Up for the Sector

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The use of European patent-protected inorganic additives to improve the characteristics of ceramic tiles is covered in this study. Modifications in shrinkage, modulus of rupture, and water absorption were noted when different kinds of additives consisting of phosphoric acid and hydrated sodium silicate were applied to the ceramic mass at varying percentages (0.15, 0.30, and 0.50 %) in a laboratory setting. It was anticipated that using both chemicals at once would

increase the slurry's viscosity and reduce the firing temperature, resulting in less energy consumption and less CO_2 being released into the atmosphere. After choosing the best combination and concentration of additives, a number of industrial tests are carried out. In industrial settings, the features of both regular ceramic mass and mass containing the chosen additive were determined without modifying process parameters, while producing monoporosa floor tiles with a water absorption of below 3.0 %. It is seen that the additives in such a small percentage reduced the fire time to 55 minutes cold-to-cold without compromising the quality of the final products. By employing lower-quality raw materials, accelerating the process, lowering the maximum firing temperature, and boosting capacity by 6.8 %, the use of additives in the manufacturing of ceramic tiles creates new potential to improve the product's mechanical and physical properties and lower production costs per unit of output. As a result, considerable energy savings and a reduced carbon footprint are achieved.

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Exhibition

"Zelenim tehnologijama do novih kozmetičkih proizvoda"
"Utilizing green technologies to develop new cosmetic products"
Miljana Mirkovic

The project "Green technologies for obtaining antimicrobial composites for use in cosmetics", "EU for Green Agenda in Serbia", with the technical and financial support of the European Union and in partnership with the Ministry of Environmental Protection, is implemented by UNDP in cooperation with the Embassy of Sweden and the European Investment Bank (EIB), with additional funding from the Governments of Sweden, Switzerland, and Serbia."